REPORT RESUMES

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ELEMENTARY SCIENCE OUTLINE, A GUIDE TO SUGGESTED CURRICULUM PRACTICES IN ELEMENTARY SCHOOL SCIENCE.

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THE COMMITTEE ON ELEMENTARY SCHOOL SCIENCE OF THE LEHIGH VALLEY SCHOOL STUDY COUNCIL REPORTS THEIR WORK ON SUGGESTED CURRICULUM FOR GRADES 1-6. THE BELIEF IS THAT SCIENCE IS A MAJOR STUDY AREA IN ELEMENTARY SCHOOL, AND SHOULD BE TAUGHT TO ALL PUPILS IN A PLANNED LEARNING SEQUENCE, WITH DUE CONSIDERATION BEING GIVEN TO THE MATURITY OF THE CHILD. CONSTANT EVALUATION, RE-EVALUATION, AND MULTI-SOURCE MATERIALS WERE CONSIDERED BASIC TO THE PROGRAM. THE MAJOR TOPICS OF ORGANIZATION ARE (1) LIVING THINGS, ANIMALS, PLANTS, (2) HEALTH AND HUMAN BODY, (3) ENERGY, MAGNETS, ELECTRICITY, LIGHT, SOUND, HEAT, (4) MECHANICS, (5) THE EARTH AND UNIVERSE, (6) AIR AND WEATHER, AND (7) CONSERVATION. TEACHING METHODS UTILIZE (1) PROBLEM SOLVING, (2) EXPERIMENTATION, (3) DEMONSTRATIONS, (4) FIELD TRIPS, (5) USE OF COMMUNITY RESOURCES, AND (6) VISUAL AIDS. SECTIONS OF THE GUIDE INCLUDE (1) PHILOSOPHY, (2) CONCEPTS AND ACTIVITIES FOR EACH GRADE 1-6, (3) REFERENCE BOOKS FOR TEACHERS, (4) SCIENCE BOOKS, (5) SCIENCE MAGAZINES, PAMPHLETS, AND BULLETINS, AND (6) FREE AND LOW-COST MATERIALS. (DH)

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ELEMENTARY SCIENCE OUTLINE

A guide to suggested curriculum practices in elementary school science

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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Foreword

This is the report of the Committee on Elementary School Science of the Lehigh Valley School Study Council. The Study Council is a voluntary association of 23 independent school districts in Berks, Carbon, Lehigh, Monroe, Northampton and Schuylkill counties, Pennsylvania, with headquarters at Muhlenberg College, Allentown.

Through the three years during which this study group worked on this curriculum, there have been both changes and additions to the group. All members are listed who have served and deserve recognition for their contributions. The asterisk* identifies those faithful members who helped develop and conclude this guide in its entirety.

This suggested curriculum is the result of many meetings and much discussion by the twenty-five members, fourteen of whom were engaged actively until its completion.

This guide does not entirely satisfy the committee members. We feel we have merely scratched the surface and that much remains to be included and revised. Perhaps the greatest value has come from selecting materials to be included and from working together. We found it necessary constantly to recognize the changing aspects of science, of our knowledge of children, and of the available materials.

We know that without the interest and cooperation of the various administrators of the schools making up the Study Council, who so generously contributed their staffs' time and participation, this curriculum would not have been possible. Special mention should be made of the devoted and untiring leadership of the chairmen, Ralph M. Messerschmidt and A. Thomas Kartsotis, and of the secretary, Lucy Frankenfield. Without their guidance and the cooperation of the administrators of their school systems (Nazareth, Bethlehem and Hellertown-Lower Saucon, respectively), the development of this guide would not have been possible. Dr Adeline Kreinheder, professor of education at Muhlenberg College, was consultant to the study group. We extend our thanks to them as well as to Dr. William M. French, Executive Secretary of the Study Council for their assistance and encouragement in stretching our horizons as science educators.

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PHILOSOPHY OF THE COMMITTEE

The various members of the Elementary Science Committee, as a group operating within and in conjunction with the Lehigh Valley School Study Council, have developed the following guide as an outline for the teaching of science in the elementary schools. The guide is in no sense a mandated course of study. Rather it is an outline, cooperatively developed, which can be used to insure a developmental science program in the elementary grades.

The Committee feels that science is a major area in the elementary school which should be taught to all pupils in a planned program of learning. However, like any other area of learning, the maturity of the pupils involved must always be taken into consideration. Therefore a constant evaluation and re-evaluation of the teaching as well as the understanding of the pupils is necessary. This is applicable to experienced teachers, the beginning teachers, supervisors, and administrators. It is also the feeling of the committee that no one textbook adequately furnishes enough material that it should be the sole reference. Hence the guide is developed around a multi-text reference background. Modern trends in teaching of science in the elementary schools lean toward a topic, or unit, approach. The objectives as defined in the guide are broad basic concepts of understanding on the part of the pupils. Since the memorization of facts, per se, is long-since outmoded due to daily- changing truths of science, it is assumed wise to dwell on the broad concept types of understanding.

Major Areas generally used in classroom teaching involved:

I. Living Things: Animals, plants

II. Health and the Human Body

III. Energy: Magnets, Electricity, Light, Sound, Heat

IV. Machines

V. The Earth and Universe

VI. Air and Weather

VII. Conservation.

The obvious necessity for the functional teaching of science in the modern elementary schools will involve problem solving, experimentation, demonstrations, field trips, and the use of community resources and audio-visual aids. At the same time, the "lecture" or "read about" teaching method is long-since outmoded.

It is the fervent hope of the committee that the users of this "Guide" will criticize constructively and revise where deemed necessary so that it is put to the most effective use in the classrooms of the Lehigh Valley.

CONCEPTS -- Grade 1

I. Animals

A. Animals are living things.
B. Animals grow.
C. Animals live in many kinds of places.
D. Some animals are wild.
E. Some animals are tame.
F. Some tame animals make good pets.
G. Animals are useful to people.
H. Animals differ in size, shape, and body covering.
I. All animals share certain basic needs.

ACTIVITIES -- Grade 1

I. Animals

A. If possible plan to keep a baby animal or animals in school for several weeks to observe its need for food and water. Fish, tadpoles, white mice, parakeets, chicks, are suggestions in science books.
B. Have children tell how they care for their pets.
C. Show all animal films that are available from the film library.
D. Visit a farm, zoo, game sanctuary, circus, or pet shop.
E. Make clay animals.

CONCEPTS -- Grade 1

I. Plants

A. Plants are living things.
B. Plants have many parts: - stems, leaves, roots, flowers, and seeds.
C. In a seed there is a baby plant.
D. A baby plant can grow if it has soil, water, light, air, and proper temperature.
E. Most plants do their growing in Spring and Summer.
F. Trees are plants.
G. Trees stay alive year after year.
H. Some plants die after a growing season.
I. Plants provide food, shelter, and clothing, and are decorative.

ACTIVITIES -- Grade 1

I. Plants

A. Use several kinds of plants to identify roots, stems, leaves, blossoms, seeds.
B. Have ready lima bean seeds that have been soaked in water overnight. Give a seed to each child and help him break it open to find the baby plant inside. Help children observe how the baby plant is different from baby animals--no hands, feet, eyes, etc.
C. Repeat the above experiment with other seeds: - corn, sunflowers, etc.

D. Plant seeds in glass jars in different positions.
Observe -- (1) Roots grow down.
(2) Stems grow up.
E. Put baby plants in various places in the room--closets, windows, dark corners, etc. Observe daily to see what happens.
F. Water some baby plants. Keep others dry. Observe results.
G. Discuss seasons in relation to planting time, harvesting time, gathering seeds.
H. Visit a garden in Spring. Observe how farmer protects seeds: - fences, scarecrows, hoeing, etc.
I. When first frost appears, have children observe garden plants to see what happened. Question them to see if they know what happens to leaves of trees, the stem of the trees, etc. throughout the 4 seasons. Emphasize that trees do not die in Winter.
J. Make charts or scrapbooks to show various uses of plants.
K. List objects in room made from plants.

CONCEPTS -- Grade 1

II. Man

A. People are living things.
B. Children's bodies change as they grow.
C. All people have basic needs:- food, clothing, shelter, care, and affection.
D. We find out about things when we see, touch, hear, taste, and smell.
E. People learn to dress properly for changing weather.

ACTIVITIES -- Grade 1

II. Man

A. Have children each bring 2 pictures of themselves for bulletin board. One picture should be a baby picture, the other picture should be as the child is now. Look for differences in the pictures. Talk about the differences--teeth, hair, size of hands, etc. Questions below should lead to proper observation of growth and change:

1. What kept the baby alive and growing:
2. Where did the baby sleep. How long did the baby sleep between feedings:
3. What care did the baby need that you do not need? Do need?
4. Who gave the baby care? Who gives you care?
5. When do children first need care of Patrolmen and Patrol Boys and girls?

B. Use toys to practice obedience to traffic signals.
C. Visit a grocery store.
D. Have daily health inspection for clean hands, teeth, neatness of appearance, etc.
E. Keep monthly weather charts and discuss proper dress for various kinds of weather.
F. Have fun programs where we enjoy things by use of one or more of the senses.

1. Feeling - have many objects in a bag. Blindfold a child. Let him pick out an object and try to guess what it is.
2. Hearing - Listen to rhymes, music, stores.
3. Seeing - Play - "I Spy" Example - I spy something round and red.
4. Tasting - Talk about a special lunch, dinner, party. What things were salty, sweet, sour, bitter.
5. Smelling - Discuss smells children enjoyed at a Fair, the movies, in the lunch room, in the garden, at home.

CONCEPTS -- Grade 1

III. Energy - Magnets and Electricity

- A. Magnets pick up things made of iron.
- B. Magnets are made in different shapes.
- C. We work and play with magnets.
- D. Some magnets are stronger than others.
- E. Magnets can pick up iron things through paper, glass, or water.
- F. We use electricity in our homes.
- G. Electricity makes some things move.

ACTIVITIES -- Grade 1

III. Energy - Magnets

- A. Have magnets of various sizes and shapes available for children to discover which of many metal objects in a box the magnets will pick up.
- B. Permit children to feel the ends of magnets to be sure there is no sticky substance such as glue or paste to hold the objects.
- C. Make experience reading charts about the magnetic experiments you do.
- D. Have children bring in magnetic toys and tell how they work.
- E. Experiment to see which of the magnets available have the most strength.
- F. Discuss uses of magnets.
- G. Let children use magnets to pick up paper clips, thumb tacks, etc. from bottom of a glass bowl filled with water.
- H. Put paper clips under a sheet of paper. Run a magnet over the surface of the paper. Observe what happens.
- I. List the electrical appliances that helped you get ready for school.
- J. List things moved by electricity and illustrate with clippings.

CONCEPTS -- Grade 1

III. Energy - Light and Heat

- A. The sun is our source of natural heat and light.
- B. Light and heat are useful.
- C. Light and heat can cause damage.
- D. The fire of a candle gives light.
- E. Heat makes water evaporate more quickly.
- F. We can use fires to give us light, to keep us warm, and to cook our food.

ACTIVITIES -- Grade 1

III. Energy - Light and Heat

A. Review value of sun as used by plants, animals, man.
B. Talk of damage sun can cause to colors of papers put on window sill, to people at the seashore, to gardens in summer time when there is too little rain.
C. Visit a fire house to create interest in fires - their uses, harm, how to control them.
D. Talk of the seasons and decide during which season the most artificial light and heat are needed.
E. Let children tell what kinds of artificial heat and light they have at home. (Candles, flashlights, gas stoves, electric stoves, driers, coal furnaces)
F. Put a small container with several spoons of water in a sunny place or on a radiator. Put a similar container with same amount of water in shade. Observe each to see when water disappears.

CONCEPTS -- Grade 1

III. Energy - Sound

A. We hear many kinds of sounds.
B. We have machines that help us tell and find out through sound.

ACTIVITIES -- Grade 1

III. Energy - Sound

A. Ask children to tell things they know because of sound.

1. An engine tells us a car is coming.
2. Footsteps in the hall tell us the teacher is coming.
3. Voices on the playground, at a birthday party, etc. tell us children are happy.
4. The fire bell tells us to leave the room.
5. The fire siren calls firemen to action.
6. Music tells you to march, sway, skip.

B. Make a chart or bulletin board display of machines that help us tell and find out through sound-telephones, TV., radios, bells, record players, whistles, and others.

CONCEPTS -- Grade 1

IV. Machines

A. Machines make work easier.
B. Wheels, levers, screws,wedges, inclined planes, and pulleys are machines.
C. Wheels help in moving things.
D. Rolling on wheels is easier than carrying.

E. Rolling on wheels is easier than dragging.
F. There are many things that move on wheels.
G. Some things on wheels are moved by people. Some things on wheels are moved by engines.
H. Our toys combine several types of machines.
I. We all use machines every day.

ACTIVITIES -- Grade 1

IV. Machines

A. Give each child in the room a piece of cloth. Ask him to tear it into 3 pieces. As comments arise about the difficulty of the task, tell the children to get out their scissors to cut the cloth. Through discussion lead children to realize scissors make the work easier. Develop idea that anything that makes work easier is a machine.
B. Look for other machines in the room. List them on board. (Pencil sharpener, doorknob, hinges on closet doors, sink stopper, faucet). Show how muscle energy is needed to make these machines work.
C. Have children bring pictures of machines used at home: - Electric mixer, snowblower, sewing machine, TV., electric fan, electric can opener, are good examples. Explain how energy other than muscles are used--wind, electricity, springs, etc.
D. Let the boys tell of machines their Daddies use:-Automobiles, Power mowers, Wheel barrows, Shovels, Rakes, etc. Re-explain the use of muscle energy, plus electricity or electric motors, and gasoline as forces of energy needed to operate the machines.
E. Experiment to see use of the 6 kinds of simple machines. Always emphasize how the work is made quicker and easier.

    1. Lever. Have children crack nuts with a nutcracker.
    2. Pully. Observe how janitor takes down flag from flagpole.
    3. Inclined plane.
    4. Wedge. Use a knife to cut an apple.
    5. Screw. Have screwdriving practice in class. Observe direction screw must be turned to be driven into the wood.
    6. Wheel & axle. Sharpen a pencil. Turn the door knob.

F. Make a toy collection. Have children discuss how the toys work.
G. Construct pinwheels. Show that large windmills are like pinwheels and are machines that are turned by the power of the wind.

CONCEPTS -- Grade 1

V. Earth and Universe

A. The earth is spherical in shape.
B. The earth is very old.
C. The earth is made up of land, water, and air.
D. The earth is always turning.
E. The turning of the earth brings daytime and nightime every day.
F. The sun is always shining.

G. Stars are very far away.
H. The sun is a star.
I. The sun gives light and heat.
J. Stars are in the sky both night and day.
K. The moon is the earth's natural satellite.
L. The moon is smaller than the earth.
M. The moon has no light of its own.
N. Space is distance out in the universe.

ACTIVITIES -- Grade 1

V. Earth and Universe

A. Observation and Experimentation.

1. Find out which side of the school gets the sun in the morning, which side gets it in the afternoon.
2. Have children feel a glass of water that was kept in the sunlight. Feel a similar glass of water kept in shade for same length of time.
3. Ask children to watch a sunset and describe it. Put pictures of sunsets on bulletin boards.
4. Was the moon out last night? If so, how did it look.
5. Use Book I of the Heath Series "Science for Work and Play" Teacher's Edition, by Herman and Nina Schneider, pages 65-67 for a cleverly devised play to show day and night.

CONCEPTS -- Grade 1

VI. Air and Weather

A. Air is all around us.
B. We cannot see air, but air is real.
C. Wind is moving air.
D. Air moves at different speeds.
E. Living things need air to stay alive.
F. Fire needs air to burn.
G. Water evaporates into the air.
H. Fog, rain, hail, snow, and ice are elements of weather.
I. People adjust to weather by change in dress habits and living habits.
J. There are 4 seasons each with certain characteristics of weather.

ACTIVITIES -- Grade 1

VI. Air and Weather

A&B. Have available balloons, party favors, paper bags. Blow into each to discover what happens. As these things inflate have children feel the air coming out. Re-fill balloons and put ears to opening to hear the air as it comes out.
C. Have each child wave a paper in still air and produce a wind.
D. Have children tell of things that happen which show that although we can't see air we can see what it does. (Ex. Fly kites, blow away

paper they take home from school, bend tree branches, ripple water in little puddles.)

E. Explain that aircontains oxygen which is gas needed to stay alive. Talk of use of oxygen tents in hospitals, oxygen suits for astronauts, etc.

F. During Halloween season cut the top off a pumpkin and take out seeds. Insert a candle, light it, observe what happens to the lighted candle when the top piece is put on. Cut out the facial features. Light the candle and put the top on. Note candle doesn't go out. Note the candle used the oxygen in the air in order to burn.

G. Put drops of water on the floor or window sill. Watch throughout the day to see what happens. Was a spot on the blackboard. Observe it dry. Wash several spots on the board. Blow on one spot. Wave a paper on one spot. Do nothing to the other spot. Observe length of time each takes to dry. Explain that when water disappears into air it evaporates.

H. Explain to children that moisture (water vapor in the air) can collect to form drops of water, sleet, or hail. Then explain that when the temperature of the air is below freezing the water droplets in the clouds form directly into snow. The facts above should be told to children as they observe weather for daily weather charts.

I. At the school sink test an old shoe, a sweater, and a rubber to see which keeps out water. Have a lively discussion of materials used for rainy day clothes. Lead children to realize that getting soaked in cold weather can lead to illness.

J. Establish fact that season means a part of the year. Let children identify activities they do some parts of the year and not at other parts. Swimming, skating, raking leaves, gathering chestnuts, planting seeds in gardens. Use present season to talk about season that will follow, how we will change our mode of dress, etc. Make a season fruit tree by putting a twig into a plaster of paris base early in fall. Tie little crepe paper colored leaves on it for Fall months. As winter approaches put on crepe paper blossoms. Before school closes for summer tell what will happen to fruit trees in July and August. Emphasize observation of fruit trees in their immediate environment.

CONCEPTS -- Grade 1

VII. Conservation

A. Water is necessary for all living things.
B. We must not waste water.
C. Many living things must be saved and protected.
D. We water small plants and trees in dry weather.
E. We keep small trees and plants safe from winter cold.
F. We put out food for birds in winter.
G. We should be careful of all fires.
H. We make laws to protect animals.

ACTIVITIES -- Grade 1

VII. Conservation

A. Slice tops from two carrots. Place one in a glass with water. Watch the green tops grow. Place the other carrot in a container without water as a control, compare the two.

B. Make a list of things which need water to live. If possible show the filmstrip--Nothing Can Live Without Water - Color - 52 frames State Library Lantern Slide section, Dept. of Public Instruction.

C. Have children suggest ways we use water. Let them decide when the using becomes a waste. Talk about ways children can save water.

D. Review weather conditions in the four sessions. Ask children to recall which season has the most clear, sunny, days. Have them tell of things their parents do to shrubs, grass, flowers, etc., when summer days are hot and dry.

E. If your school is in a town or city, ask children to look for ways people protect their small shrubs in winter.

F. During Fire Prevention Week relate work of firemen in state parks, wooded areas, etc. to conservation in reference to soil, wild life, etc. Have children join Smokey Bear's official Junior Rangers and get the Junior Ranger Kit. Write to: - Smokey Bear Headquarters
Washington 25, D. C.

G. Let children whose parents have bird feeders at home tell how the feeder is made, what food they give the birds, what birds eat the food, etc. Encourage children to ask parents to construct feeders.

H. Show film - Christmas for the Birds - Sound - Color - 24½ minutes,
Rothchild Films Corporation
1012 E. 17th St.
Brooklyn 30, N.Y.

I. During hunting season in Fall and fishing season in Spring talk of the need to have only a special time for hunting and fishing. Have children bring in old licenses. Discuss reasons for licenses.

CONCEPTS -- Grade 2

I. Animals

A. Animals respond to climatic changes by: - migration, hibernation, camouflage, moulting.
B. Animals get food by natural methods through use of their body parts such as bills, claws, sharp teeth, speed of locomotion, etc.
C. Man helps some animals get food.
  1. Feeding stations help.
  2. Helicopters are used to help carry food to animals when severe weather conditions exist.
D. Animals are protected from enemies by color, speed, odors, body parts.
E. Man uses animals for food, clothing, transportation, companionship, and research.

ACTIVITIES -- Grade 2

I. Animals

A. Have the children prepare a list of animals that are helpful to man; also a list of animals that are harmful to man. Let them illustrate these lists with pictures of animals cut from magazines or drawn by themselves.
B. Discuss the value of owls to man, stressing their harmlessness.
C. Construct a bird feeder.
D. Make a collection of deserted birds' nests in late fall. Note their similarities and differences. (Spray with insecticide)
E. Using an incubator, hatch baby chicks or ducks from eggs.
F. Observe an animal such as a squirrel or bird at various times over a period of time and try to decide which actions can be attributed to changes in seasons.
G. Set up an ant colony. Observe with a magnifying glass.
H. Collect pictures of animals which store food for winter, which go to sleep in protected places, which travel to warmer countries for winter, and those which remain active and must find food in winter. Mount them in groups on the bulletin board.
I. Visit a farm to observe and learn about care and feeding of farm animals at different seasons.
J. Plan a pet show. Have the participants tell how they care for the pet.
K. Collect pictures of animals in their summer clothes and in their winter wraps.
L. Observe film -- "Mother Hens Family."

CONCEPTS -- Grade 2

I. Plants

A. Most plants have parts known as stems, leaves, roots, flowers, seeds, buds.
B. Each part of a plant has a specific function in the life cycle of

the plant.

- C. Many parts of plants are valuable for food.
- D. Some parts of plants are used to reproduce the plant.
- E. Plants may be classified as flowers, grasses, shrubs, vegetables, fruits, trees, etc.
- F. Trees are our largest plants.
- G. Trees may be classified as deciduous and evergreen.
- H. Woody plants often have buds from which leaves and flowers develop.
- I. New plants grow from seeds, bulbs, stem cuttings, called slips, leaves, and spores.
- J. Plants need proper amounts of good soil, water, light, temperature air for growth.

ACTIVITIES -- Grade 2

I. Plants

- A. Plant lima beans and corn behind glass so that the roots may be seen growing downward and the stems growing upward. Study some beans by taking them apart to see which part becomes root and which part becomes stem.
- B. Raise plants from slips by putting pieces of geranium, begonia, cuttings of ivy, or willow twigs in water.
- C. Keep a few potatoes in a dark place until sprouts appear. Observe from what part of the potato the sprouts grow. Determine the use of the rest of the potato to the young plant.
- D. Plant seeds of trees, garden plants, in germinating boxes or other suitable containers. Keep records of their growth.
- E. Take a walk around the school grounds to observe the variety of plant life. Visit the same plants during the four seasons to see the changes taking place.
- F. Make a seed collection of different kinds of plants. Examine the seeds with a magnifying glass to note their similarities and differences.
- G. Make a list of plants we eat, and the parts of the plant we eat.
- H. Make a chart showing the uses and value of plants to man.
- I. Visit an area where a tree was recently cut down. Count the rings in the trunk. Observe to see if any animals have made it their home and if fungus has appeared.
- J. At Christmas time make a simple study of different kinds of evergreens. Note the differences in their needles and cones.
- K. Identify poison ivy and other poisonous plants around the school. Be sure each child can recognize them.

CONCEPTS -- Grade 2

II. Man

- A. People must depend upon plants and animals for their existence. There is interdependence among living things.
- B. All parts of the human body need special care for proper growth and development.

C. Cleanliness is an asset for health and beauty of body parts.
D. To keep from being physically injured safety rules must be learned and observed.

ACTIVITIES -- Grade 2

II. Man

A. Observe that both man and animals depend on some plants and some other animals for food.
B. Some parts of our bodies need to be cared for in different ways. For example, we trim our own nails but not our own hair.
C. We wash our hands more frequently than our hair; our teeth need proper and regular brushing. List ways in which we keep our bodies clean for health and beauty.
D. Why do we have safety rules? List some very necessary rules for school safety; home safety, etc.

CONCEPTS -- Grade 2

III. Energy - Magnets and Electricity

A. We can move some things with magnets.
B. We cannot move all things with magnets.
C. Some magnets are stronger than other magnets.
D. We can use a magnet to make other magnets.
E. The compass is a magnet.
F. Magnets have ends called poles. There is a north - seeking pole and a south - seeking pole.
G. Electricity works for us at home, in factories, in schools, on the street.
H. Electricity can be made by friction, power plants, and batteries.
I. Electricity moves through wires.
J. Electricity gives us light, heat, power to run motors, and sound.

ACTIVITIES -- Grade 2

III. Energy - Magnets and Electricity

A. Ask the children to try to determine which substances magnets attract. They can collect assorted scraps, then sort them into two piles: those which are attracted by magnets and those which are not. Be sure to first identify those objects with a high percentage of iron.
B. Make a display of magnets used in the kitchen, workshop and other places. (Magnetic door latches,' bulletin board, holders, screwdrivers, hammers, etc.)
C. Find games that use magnetism to make them work and learn how they work.
D. Wind neatly two or three layers of wire on a large spike or bolt. Connect the ends of the wire through a switch to a dry cell. Close the switch and try to pick up some nails or other iron objects. Holding the nails with the magnets, open the switch. Test the electromagnet with a compass needle to find which end is the north

pole. Interchange the wires to the dry cell and test again. The position of the north pole depends on which way the current is flowing thus the polarity may easily be controlled.

E. Look for electromagnets used in the home and school. Demonstrate electric motor, telephone, telegraph, door bell, etc.
F. Make the children aware of safety precautions when working with electricity. Develop safety rules as the unit develops.
G. Carefully breaking the glass of a discarded light bulb (wrap with a dampened cloth), examine the filament and construction of a bulb.
H. Provide time for each child working in a group to construct a simple circuit using bell wire, a battery, and a light or bell. When the circuit is constructed, add a push button switch or a knife switch.
I. Trace the circuit in a flashlight.
J. Disassemble discarded worn-out electrical equipment. Examine the wiring.

CONCEPTS -- Grade 2

III. Energy - Light and Heat

A. The sun is always shining. It gives us light and heat.
B. Day begins when the sun comes up and lights up our part of the earth.
C. Light travels in a straight line.
D. We can get artificial light and heat from candles, kerosene, gas, and electricity.
E. Heat makes things move.
F. Heat makes things larger.
G. Too much heat causes fire.
H. Fires need air (oxygen) to burn.

ACTIVITIES -- Grade 2

III. Energy - Light and Heat

A. Collect and mount pictures illustrating the benefits of the sun to health, to plants, to animals, etc.
B. Observe how leaves of plants in a window turn toward the light.
C. Observe shadows to see how they are made and how they may change.
D. Collect pictures of materials used to light and heat homes in the past: candles, lamps, oil, coal, wax, etc.
E. Experiment: Some things heat faster than others. Place a thermometer in a dish of water, and another thermometer in a dish of soil. Put the dishes in the sunshine, put them in a refrigerator. Observe the changes.
F. Blow up a balloon and see how much string is needed to go around the balloon. Place the balloon over a radiator or hot plate for a few minutes. Measure the distance around the balloon with another string.
G. Make a list of fuels that can be used to give us heat.
H. Check with the Pennsylvania Teaching Guide to Natural Resources Conservation #7 by Dept. of Public Instruction, 1962

CONCEPTS -- Grade 2

III. Energy - Sound

A. Sounds come to our ears through the air.
B. Sounds are caused by vibrations.
C. Sounds made in different ways sound differently. They may be soft, loud, high, low.
D. Sounds differ in intensity and pitch.
E. Vocal chords vibrate to produce sound in animals and people.

ACTIVITIES -- Grade 2

III. Energy - Sound

A. During a minute of silence in the classroom have the children listen for different outside sounds they can recognize: dog barking, an airplane, an automobile, wind whistling, footsteps, etc.
B. Have children detect sound vibration through a variety of materials: triangles, cymbals, bells, piano, violin, etc. Sprinkle sand on drum and beat drum. Also beat drum without sand.

CONCEPTS -- Grade 2

IV. Machines

A. A machine is any device that aids in doing work.
B. Machines are made of simple machines.
C. Springs help things move.
D. Gears help things move.
E. Wheels help things move.
F. Wheels must have axles in order to make work easy.
G. Levers make work easy.
H. Machines need power to do work.
I. Power may be man power, animal power, water power, engines and motors which use electricity or fuel for energy, jet power, solar heat.

ACTIVITIES -- Grade 2

IV. Machines

A. Look at home and school to find machines that lift, push, pull, grind, chop, dig, carry, and do other things that need to be done in our everyday living.
B. Look at toys to find wheels, levers, pulleys. Show the class how the toys work.
C. Observe to find what makes machines move: which machines are moved by electricity, by wind, by water, by springs, by muscles, etc.
D. Make pictures of wheels, levers, pulleys and ramps that are used in the home and schools.
E. If there is a new building under construction in the area of the

school, take the class on a field trip to observe the many machines at work.

F. Obtain a board about four feet long from your custodian. Place the board on a block and allow children to experiment lifting heavy objects.

CONCEPTS -- Grade 2

V. Earth and Universe

A. The earth moves very fast. (It makes a complete turn once each day.)
B. The earth has a pulling force called gravity.
C. The earth has atmosphere.
D. There is space beyond the air ofour earth.
E. The sun is a hot, bright star.
F. All stars are hot and very far away.
G. Without the sun there would be no life.
H. The moon is smaller than the earth, sun, or all known stars, but it looks larger because it is closer to us.
I. There is no water or air on the moon.
J. The moon moves around the earth once every 28 days.
K. The earth, stars (sun) and moon all move in space.

ACTIVITIES -- Grade 2

V. The Earth and Universe

A. Pour water into a jar partly filled with soil to show that there is air in soil.
B. To show that there is air in water, note the bubbles formed along the inside of a glass in which water has been standing for a few minutes.
C. To show that clouds are made from water in theair, boil water in a teakettle. Notice the cloud of white material which forms near the spout, but not directly at it. This is a true cloud, caused by the cooling of the steam which comes from the kettle. Notice the seemingly empty space at the spout. This space is filled with water in the gaseous state (steam). One cannot see steam.
D. To show that air takes up more space when it is heated, fasten a toy balloon over the mouth of a flask. Set the flask on top of a warm radiator or other source of heat. The balloon will inflate. Set the flask and balloon in a cool place. The balloon will deflate.
E. Demonstrate that water can take one of three forms: solid - ice, liquid - water, gas - steam or vapor. Melt some ice cubes until they become a liquid. Heat the liquid until it boils and produces steam. Hold a plate above the boiling water and condense the steam to water.
F. Use Trippensee Planetarium, $96.50 N. D. E. A. Approved.

CONCEPTS -- Grade 2

VI. Air and Weather

A. Air is all around us.
B. Air takes up space.
C. Air has weight.
D. There are many phenomena of weather - clouds, rain, wind, fog, snow, ice, sleet, thunder and lightning, rainbows, sunshine.
E. Temperature is an important factor in determining what the weather will be and in determining our daily activities.
F. Weather changes are daily and seasonal.
G. Man devises ways to protect himself from floods, fog and ice.

ACTIVITIES -- Grade 2

VI. Air and Weather

A. Put a sheet of newspaper on a desk. Put a ruler under the newspaper. Let ruler extend over end of table. Hit ruler sharply with edge of hand. Ruler will break.
B. Collect pictures of different kinds of weather throughout the world.
C. Watch clouds at different times to see how they change (in size, color, shape and movement) and to see the different kinds.
D. Interest the children in forecasts by the Weather Bureau as reported in the newspaper and by television and radio.
E. Encourage the reading of thermometers. Use the large cardboard model to explain the reading of a thermometer.
F. A cloud may be compared to a sponge, holding water. Soak a sponge with water, squeeze it gently. When a cloud gets colder it cannot hold so much moisture. Some of the water drops from the cloud as it did from the sponge when it was squeezed.
G. Make a list of all the uses of rain to man.

CONCEPTS -- Grade 2

VII. Conservation

A. The source of pure fresh water is rain, sleet, hail, or snow.
B. We need water to live.
C. We sometimes waste water.
D. Soil is the top layer of earth which gives us food, clothing, and shelter.
E. Soil is sometimes lost, but there are ways to save soil.
F. Trees provide many of our needs.
G. Trees have many enemies. (Insects, fires, diseases).
H. Wildlife is important to us.
I. Rocks are made of minerals. Minerals are non-renewal resources so should be used wisely.

ACTIVITIES -- Grade 2

VII. Conservation

A. Discuss the kinds of clothing we get from wildlife and domestic animals and different kinds of plants. Children may want to look in old magazines for pictures.

B. Make trips to farms, wood lots, and grocery stores to learn to identify plants, animals and foods.
C. Take a trip to a well-sodded sloping area. Dig up a clump of sod and note how soil clings to the grass roots. A good sod holds soil in place.
D. Study the different kinds of soil samples collected by pupils on field trips to see how they differ in color and texture.
E. Make a list of plants:
   Those grown for food and erosion control on farms and in gardens and orchards. Those grown for wildlife and cover.
F. Make a minature farm in the classroom and show conservation practices.
G. Measure the amount of silt in a jar of muddy water taken from a stream after a rainstorm.

CONCEPTS -- Grade 3

I. Animals

- A. There are both sea animals and land animals.
- B. Some sea animals live close to the surface of the ocean; others live far below the surface where it is always dark and cold.
- C. Animals adapt to their environment.
- D. Some animals are carnivorous, some herbivorous, and some omnivorous.

ACTIVITIES -- Grade 3

I. Animals

- A. Pet Show -- encourage children to discuss.
- B. Draw pictures of various animals.
- C. Have children see likenesses and differences in the shapes and sizes of animals.
- D. Look at pictures of how animals secure their food.
- E. Prepare pictures as to how animals escape their enemies.
- F. Identify various animals.

CONCEPTS -- Grade 3

I. Plants

- A. There are both sea plants and land plants.
- B. Sea plants make sea life possible.
- C. Sea plants take in minerals, air, and sunlight for growth.
- D. Plants have ways of being protected from their enemies. Example: thistles, thorns, etc.
- E. Some plants conserve water for a long period of time. Example: Cactus.
- F. Plants survive better in a group rather than alone.

ACTIVITIES -- Grade 3

I. Plants

- A. Plant seeds in classrooms.
- B. Identify poison ivy and sumac.
- C. Observe plants in the neighborhood.
- D. Identify dandelion, broad and narrow plaintan, burdock, Queen Anne's lace, beggar's ticks, golden rod, etc.
- E. Study various methods of seed dispersal.
- F. Plant water plant in an aquarium (elodea, watercress).
- G. Make a cacti terrarrium.

CONCEPTS -- Grade 3

II. Man

- A. Our five senses help us enjoy life if we use caution and if we practice good health and safety habits in caring for them.

1. Eyes are for seeing. Nature protects eyes by means of eyelids, eyelashes, tears, and the bony structure over the eyes and under the eyebrows.
2. Ears are for hearing. Ears should be cleaned gently with plenty of water, soap and a soft cloth. They should be protected from hard blows, cold, and very loud noises.
3. Hands are for touching. Hands and nails should be kept clean.
4. Noses are for smelling.
5. Mouths and tongue, are for tasting.

B. Exercise helps stimulate the appetite, builds strong muscles, and strengthens the heart and lungs.
C. Good posture is an aid in preventing fatigue.
D. There are safety signs along the road that help keep us safe when we are walking on the highway or riding in a car.
E. We need well-balanced meals if we want to be healthy.
F. Proper care of colds includes getting plenty of sleep and rest, drinking fruit juices, staying home to avoid chilling - and to avoid spreading cold germs.
G. Our 20 primary (baby teeth) are formed to fit our mouths and take care of our chewing needs when we are young. The larger 32 permanent teeth are more suitable for these purposes when we grow up.
H. Teeth need proper care.

ACTIVITIES -- Grade 3

II. Man

A. Show what a balanced meal consists of.
B. Chew a cracker/piece of bread slowly. Note change in taste.
C. Pupils close eyes -- discuss sour pickles -- What happens?
D. Observe -- "Visible Man"
Observe -- Skeleton and muscle charts, also blood vessels.
E. Discuss digestion.

CONCEPTS -- Grade 3

III. Energy - Magnetism

A. There are several kinds of magnets, (sizes vary, shapes vary).
B. Magnets have many uses.
C. Magnets have a North and South pole.
D. A compass needle is a magnet that is free to move.
E. Around every magnet there is an area of attraction called the magnetic field.

ACTIVITIES -- Grade 3

III. Energy - Magnets - Electricity

1. Sprinkle iron filings on piece of glass or cardboard which is over a magnet.
2. Compare likes and opposites of magnetic poles or magnets by placing

them near each other.
3. Rub a nail on a magnet.
4. Make an electromagnet.
5. Take wire, battery, socket, bulb and switch from Science Kit and make a complete circuit and let pupils open and close switch.
6. Let children list and/or illustrate daily uses of electricity in their lives.
7. List tools or machinery which use electricity.

FILMS: Electricity All About Us
Electromagnets
Flow of Electricity
Michael Discovers the Magnet
Magnets

CONCEPTS -- Grade 3

III. Energy - Electricity

A. Electricity is a form of energy.
B. Electric current flows in a circuit.
C. Electric circuits must be complete for electricity to go through.
D. A switch is a device that controls the flow of electricity.
E. The fuse is the weakest link in the electric circuit.
F. Electric current makes things move and gives light and heat.

ACTIVITIES -- Grade 3

III. Energy - Electricity

1. Discuss how many ways electricity is used in our homes. Make a list of things we do in a day which are possible only because of electricity. Exhibit pictures cut out from magazines of uses of electricity in the home.
2. Have children try to wire a complete circuit using a wire, a dry cell, and electric light or bell. Add a switch to the circuit.
3. Make a list of switches used in the home and school.
4. Experiment with insulators and conductors placed across a gap in a circuit. Have the children place the insulators in one pile and the conductors in another. Have them note the differences between insulators and conductors.
5. Electromagnet. Wind ten turns of wire around an iron rod. Connect this to a dry cell. Test the electromagnet attraction with various materials. Add a switch to the circuit. (Do not leave the switch closed any longer than necessary. This is important since the kind of use involved is hard on dry cells.) Using the arrangement above pick up as many nails as possible, at one time, with your electromagnet. Drop these in a pile and count them. Return them to the original pile. Record the results on a table similar to the one below. Repeat this for a total of three trials.
   Follow the same procedure substituting twenty turns of wire for the

original ten. Next, add an additional dry cell in series.

ARRANGEMENT	TRIAL 1	TRIAL 2	TRIAL 3	AVERAGE
1 dry cell, 10 turns				
1 dry cell, 20 turns				
2 dry cells, 20 turns				

6. Develop safety rules for the home and school when working with electricity.

CONCEPTS -- Grade 3

III. Energy - Light and Heat

A. Heat and light may be natural or artificial.
B. Some of the sun's light and heat reach the earth.
C. The light and heat from the sun are necessary to life on earth.
D. Heating produces light.
E. Light goes through some things and is reflected by others.
F. A prism breaks light into colors of the rainbow.

ACTIVITIES -- Grade 3

III. Light

A. Pull shades and shut out as much light as possible. Have the children observe the difference in appearance of classmates and objects in the darkened room. Have the children try to do things ordinarily done in a lighted room, such as writing, reading; repeat these activities in a lighted room. Compare the results. Discuss the need of light in order to see.
B. Discuss the sources of direct light, such as fire, candle, lamp light, electric light.
C. Discuss the need for wearing something white to reflect the light while walking on the streets or highway at night. Have the children list places where white is necessary for safety, as in dark corridors, stairways.
D. Use a strong light from the sun or from a projector to cast shadows. Make shadow pictures using hands or objects.
E. Discuss why blinds are placed at windows. Explain, demonstrate, or use pictures to show the values of different kinds of window shades.
F. Discuss how the sun helps to supply us with one of the following: a juicy steak; a cotton shirt; a woolen sweater; a ton of coal.
G. Demonstrate the heat of the sun's rays. Concentrate sun rays through a magnifying glass (care must be taken to avoid fire.)
H. Place one glass of water in direct sunlight. Place another glass of water in the shade. After an hour feel the water in the two glasses and compare the temperatures.

I. Observe the changing length and direction of shadows, and the direction of the sun itself. Activities such as sketching shadows of the children on sheets of butcher paper or making sun dials likewise can be directed toward developing basic knowledge of the sky and light.

J. (a). An interesting sundial can be easily constructed on the schoolroom floor or better yet on the sidewalk nearby. With the footprints of a child marked on the walk, the direction of his shadow can be marked at hourly intervals with lines radiating from the center where the child stands. To use the sundial later, all a child need do is step onto the footprint and note the direction of the shadow.

(b). Another type of sundial can easily be constructed from a pencil and an empty thread spool. Insert the pencil into a spool. Stand this in the center of a large piece of paper. Place it in a sunny room. Mark off the position of the shadow each hour and half-hour. Use the sundial to tell time.

K. Use a prism in the sunlight to break white light into colors. Make a drawing of a light beam, a prism, and the spectrum to illustrate that white light is composed of all colors.

L. Find a piece of glass about 6" square. Cut a piece of black paper the same size. Cut a piece of wax paper that size. Now light a lamp (flashlight or filmstrip projector) and hold the glass between you and the lamp. Try the black paper in the same way.

M. Stand in a window and use a mirror. Hold the mirror in such a way that the bright sunlight hits it. Move it slowly about. You will find a reflection of the sunlight on the wall or ceiling.

N. Find a piece of white paper and a piece of black paper side by side on a table. Each piece should be at least six inches square. Darken the room. With a flashlight or filmstrip projector, point a light on the black paper and notice the amount of light in the room. Point the light on the white paper and notice again the amount of light in the room. The white paper reflects more light.

CONCEPTS -- Grade 3

III. Energy - Sound

A. Sound is caused by a vibration.
B. Sounds are made by many animals, and things.
C. Sounds are vibrations which travel in many directions through many materials.
D. Sounds are used for communication.

ACTIVITIES -- Grade 3

III. Energy - Sound

A. Strike a triangle to make it vibrate. Listen to the sound. Touch it to stop the vibration. Listen again. In order to see that the triangle is actually vibrating, thrust it into the water after it has been struck and note the waves of water that travel out from it.

B. What causes sound? Turn a can or box upside down and place some grains of sand on it. Tap the bottom of the can or box with a pencil. (The grains of sand bounce up and down and the box makes a drumming sound.)

C. Stretch a rubber band between two chairs. No sound comes from the rubber band. Now pluck the band with your fingers. It begins to vibrate. Listen for the hum.

D. Hold one end of a steel knitting needle on the edge of a table. Pull the needle upward and then let it go quickly. How would you describe the movement of the needle?

E. Put your fingers to your throat. You cannot feel any vibrations, can you? Now talk to someone. What happens?

F. To learn how sound travels make a tin can telephone. Use two cans, two buttons and several feet of wire or string. The cans should have one end removed neatly so they will be safe to use. Punch a small hole in the center of the bottom of each can. Thread one end of the string through this hole to the inside of each can and tie it to the button. The telephone is used by two children standing far enough from each other to hold the string taut. One speaks into the can, holding it close to his mouth. The other holds the can to his ear. In answering the process is reversed.

G. Tuning fork. Strike a tuning fork against a rubber heel. While it is still vibrating, plunge it into a shallow pan of water. The water flies in every direction because the prongs of the tuning fork are vibrating. Did the hum of the tuning fork stop when the vibrations stopped? Try the experiment again and see if this is true. Strike the tuning fork against the rubber heel again. Hold the fork very close to your cheek. Feel the air from the moving prongs. Listen to the sound of the tuning fork. When the hum of the fork stops, can you still feel the air near your cheek? Strike the fork once more. Listen for the sound. Quickly put your hand on the prongs of the fork. You feel them vibrate. As soon as you touch them, they stop vibrating. The sound stops also.

H. Discuss how Indians put their ear to the ground to hear how far away their enemies were, or bison and other animals they wanted to hunt.

I. Make musical instruments that demonstrate the scale of musical sounds--a bottle scale made of bottles with varying amounts of water in them; a glass scale made in a similar manner; a scale made with strips of wood of various lengths; a scale made by driving nails into a block of wood.

J. Make a list of sounds that are warnings to us--rattle of a rattlesnake, snorting of a bull, hissing of a cat, fire alarms, warning bells at a railroad crossing, screeching of car brakes, or the scream of a child.

K. List sounds under such categories as pleasant sounds, unpleasant sounds, early morning sounds, noontime sounds, trouble sounds, winter sounds, summer sounds, and highway sounds. (A tape recorder can be a very effective device in this activity.)

CONCEPTS -- Grade 3

IV. Simple Machines

A. Machines make work easier.

B. There are six simple machines known as the (1) lever, (2) pulley,

(3) wheel and axle, (4) inclined plane, (5) wedge, and (6) screw.

- C. Levers make work easier.
  1. Levers reduce the force needed to lift objects.
  2. The position of the fulcrum affects the amount of force needed to lift an object and the distance it can be lifted.
     - a. The nearer the fulcrum is to the weight, the less force is needed to lift the weight.
     - b. The nearer the fulcrum is to the force, the higher the weight can be lifted.
  3. Some levers pry, some pull, some twist.
  4. Some levers help to move things quickly.
- D. Pulleys can be used to make work easier.
  1. Pulleys are used to change the direction of the force.
- E. The wheel and axle make work easier.
  1. It is easier to roll a load on wheels than to drag it.
  2. Some wheels help us to do work faster.
  3. Wheels with teeth are called gears.
- F. Inclined planes make work easier.
  1. It is easier to push or pull an object up an inclined plane than to lift it straight up.
  2. The longer the inclined plane, the less force is used, but the distance traveled is greater.
- G. The wedge makes work easier.
  1. A wedge is two or more inclined planes put together.
  2. More work can be done with a large wedge than a small one.
  3. With a wedge, distance can be traded for force.
- H. The screw makes work easier.
  1. A screw is an inclined plane that winds around instead of going straight.
  2. A screw may be made to move into or through something.
- I. Friction is resistance that occurs when one object rubs against another.
  1. When there is much friction, some force is lost overcoming the friction.
  2. Wheels help reduce friction.
  3. To make machines work better, friction can be reduced by using some form of lubrication.

ACTIVITIES -- Grade 3

IV. Machines

1. Examine "wind-up" toys.
2. Demonstrate use of hammer, screwdriver, wrench.
3. Use claw hammer to pull nails.
4. Examine pulleys found in Science Kits.
5. Examine chain drive on a bicycle.
6. Let pupils observe belts, and how they function, on a motion picture projector.

FILMS: Our World of Science
Machines Do Work

Machines Help Us
Simple Machines: Levers
Simple Machines: Inclined Planes
Simple Machines: Pulleys
Simple Machines: Wheels and Axles

CONCEPTS -- Grade 3

V. Earth and Universe

A. Earth
1. Develop the concept that the earth is very old.
2. The earth is geometrical (pear-shaped) in shape.
3. Is made of land, water and air.
4. Everywhere under the land and water there is solid rock.
5. Soil covers most of the rock.
6. The earth moves rapidly.
7. The earth has pulling force called gravity.
8. The earth has space around it.
9. The earth belongs to a system of planets called the solar system.

ACTIVITIES -- Grade 3

V. Earth and Universe

A. Make a collection of rocks and stones found in your neighborhood. Note whether rocks are plentiful or whether the children have difficulty finding specimens. Note whether there is variety in the rocks collected.

B. Draw a make-believe country. Include in it: the four main directions, a river, lake, ocean, mountains, an island, and any other features the children wish. Show with a marked trail a trip that might be made through this make-believe country.

C. Have the children make pictures or models to show some of the earth's surface features such as mountains, canyons, islands, dunes, plains, beaches and geysers. These features may also be shown in three-dimensional models made of papier-mache, ceramic clay, or non-hardening oil-base modeling clay.

D. Study the make-up of soil. Find a place where permission can be secured to dig up all the soil in an area twelve inches square and six inches deep. Dig up the soil and put all of it in a pan or box. Be sure to get all of the living things that were in this soil. Carefully begin to separate the soil. This may be done indoors, newspaper spread out on a table or floor will make a good place to work. This may be done outdoors if there is a suitable place. Then as the soil is examined it can be spread out. If a hand lens is available, the children will be able to see some of the smaller things more clearly. Keep a list of everything that is found. Not all soils have the same kinds of things in them. Frequently in addition to the grains of sand or clay particles one can see parts of decaying plant leaves, stems, or roots, parts of animal bodies, larva or pupa of insects, adult insects, earthworms, spiders and other small animals. When all have looked at the soil, unless there is a good purpose apparent to the children, be sure to put it back in the place from where it was taken.

E. Find which soil material will hold the most water. Small amounts of sand, clay and humus, four empty tin cans of the same size, and four pieces of double-thickness cheese cloth, each large enough to fit well over the end of the can being used, will be needed. Cut the tops and bottoms out of the cans. Tie a piece of cheese cloth over the bottom of each can. Put equal amounts, about two-thirds of a can, of each sample, sand, clay, and humus in separate cans. Mix one-fourth can of sand, one-fourth can of clay, and one-fourth can of humus together and fill the fourth can two-thirds full with this mixture. Secure four containers that will hold water and that are larger around than the tin cans already suggested for the samples. Support each of the cans containing samples over one of the larger containers. Pour equal amounts of water into each top can. Measure the amount of water that has run through each sample after five, fifteen, and thirty minutes.

F. Examine the school's rock and mineral collection. Note the similarities and differences: color, hardness, shape, size, etc.

G. Visit an area around the school where rocks are being eroded into soil. Encourage the children to find broken pieces of rock and to try to discover what broke them off from larger rocks. Find plants or trees growing on rocks, or pictures of them. Watch run-off rivulets after a rain and observe the silt. Put samples in glass jar and note the amount of settling.

H. Discuss children's experiences with various land and water forms. Let them illustrate each type with drawings or with pictures from books and magazines.

I. Take a field trip to a "cut" along a road, where the layers show how solid rock breaks up and becomes soil.

J. Collect pictures from weekly readers and other periodicals and stories of geologists and astronomers studying the earth and sky. Note the instruments they use. Encourage the children to search in encyclopedias and references for illustrations and descriptions of these theories.

K. Observe a baked apple as it cools, and see how "mountains" and "valleys" form in its surface.

L. Gather a handful of rich humus and study it under the magnifying glass, microscope, or microprojector to observe the plant, insect, and animal remains, and the fine dark dust (silt) in it.

M. Let each child examine and work with the globe. Plan imaginary trips around the world.

CONCEPTS -- Grade 3

V. Universe

A. The moon is lit by reflected light from the sun.

B. The moon is only about one-fourth as big as the Earth.

C. The moon travels around the Earth once every 28 days.

D. An eclipse of the moon is caused when the moon comes into the earth's shadow.

E. The moon seems to change its shape as it travels around the earth.
F. There is no "man in the moon." The spots that resemble the facial features of the man are in reality big flat places and/or mountains.
G. The moon's gravity causes tides on the earth.
H. Our sun is a star.
I. They are the largest things we know about.
J. Our sunlight is so bright that it fades the light from other stars during daytime.
K. Many stars seem to be arranged in groups or constellation. Some names are: The Big Dipper, The Little Dipper.
L. Space is not empty. Space contains dust and other particles.
M. In space we have many other solar systems which, with our own, help to make the Universe.

ACTIVITIES -- Grade 3

V. Universe

A. Demonstrate movements of the earth and moon with the Trippensee Planetarium.
B. Draw a circle on the blackboard a quarter of an inch across. Beside it make another circle twenty-seven inches across. The sizes of these circles show how much larger the sun is than the earth.
C. Using an almanac, find out how many hours of sunlight we have on the first day of each month.
D. Take a make-believe trip to the moon. Tell about all the things you would need to take with you, how you would get there, and how you would get back to earth again.
E. Collect pictures from magazines of rockets and satellites.
F. Place a pin on the globe at Bethlehem's location to represent a child. Let a child turn the globe from west to east to see where we are in relation to the sun during the day and night.
G. On a cold quiet day the children can feel the differences of heat in the sun and in the shade, even though the earth has air. Paste a small mirror on a ball to represent the moon. Shine an electric light (sun) on the mirror to show how the moon reflects light. Feel the mirror to see if it is warm.
H. The moon's revolution can be demonstrated by setting up a light (sun) and having two balls of different sizes represent earth and moon. Carry the moon around the earth for children to observe how light from the sun reflects from the moon.
I. Watch for the moon in the daytime sky, and keep a record of the dates when it can be seen. Repeat the observation for two or three months to find if it can be seen regularly every four weeks, and for how long.
J. Discuss differences between rockets, jets, and satellites. Check news releases. Classroom science periodicals are a valuable aid in keeping up with current launchings of space vehicles and in learning the nature and purpose of each type.
K. Make a miniature diorama of our solar system by suspending balls

of papier mache or other material in a large cardboard box. This device can be used to show relative sizes of planets.

L. Heat a wire until it glows. Feel the heat and see the light produced by the wire. This, in a small way, represents the glowing gases of the sun. The wire has been externally heated to the "glowing" stage. The sun however, is heated to this stage internally, by the nuclear reactions between the hydrogen and helium it contains.

M. Check newspapers and science bulletins for listings of visible planets, and hunt information telling in what part of the sky each planet is likely to appear.

N. Find out the significance of each planet's name.

O. Look for pictures taken of stars through telescopes.

P. Discuss the difference between stars producing light and planets reflecting light. Shine a light on a mirror or pie pan and note the reflection on the ceiling or wall.

Q. To make a star twinkle in the classroom, cast the image of a small bright source of light on a screen and place a heat source between the light and the screen. A flashlight bulb or automobile stop light bulb can be used. To focus the light on the screen use a convex lens. This lens can be mounted in a cardboard box in order to make it high enough to be directly in front of the light and then place the screen so that the light is focused on it clearly. Then place a Bunsen burner or hot plate near and below the lens. The image on the screen will tremble and shift as a star does, because the rising heat waves disturb the atmosphere between the lens and the screen. Turbulence can be observed above an asphalt road on a hot day.

R. Set up a three-dimensional, make-believe Big Dipper in a cardboard box. Suspend the stars to look like the Big Dipper, from the front, to be on different planes when viewed from the top.

CONCEPTS -- Grade 3

VI. Air and Weather

A. Air is important to all living things.
   1. Air has oxygen.
   2. People need oxygen to live.
   3. All animals need oxygen to live.

B. Weather is of importance to all living things.
   1. Weather affects our daily lives.
      a. Homes
      b. Clothing
      c. Food
      d. Recreation
   2. Weather affects other living things.
      a. Animals (birds, insects, others)
      b. Plants

C. Weather changes daily and seasonally.

D. Man must learn to protect himself from dangers caused by weather, (floods--fog--ice--winds)

ACTIVITIES -- Grade 3

VI. Air and Weather

- A. Air is important to all living things:
  - 1. Develop the understanding that air is composed of several gases - some are helped; some are harmful in isolation.
  - 2. Collect and discuss newspaper articles dealing with smog problems in various sections of our country.
  - 3. Develop the understanding that all animals breathe. In the respiration process, oxygen is utilized by the bodies of the animals.
- B. Collect pictures of "homes" from various part of our world.
  - 1.a. People who live in tropical areas do not need heating systems such as we have. Develop an understanding of why we use storm windows on our homes in winter.
    - b. Collect pictures of clothing worn by people from various parts of our world.
    - c. Develop the understanding that some foods exist in greater abundance at various times of the year - due to changes in weather. Room here for economics, too. The fluctuating prices of vegetables for example.
    - d. List the various forms of recreation (sports for example) which are popular at the various times of the year. Discuss reasons why.
  - 2.a. Discuss migration of birds - hibernation of animals and insects - develop appropriate vocabulary.
    - b. Discuss reasons why some plants grow during spring, summer and autumn then are dormant during winter. Others grow during spring, summer and autumn then die leaving seeds to grow the next year.
- C. Observe and record temperature as well as other conditions daily. Compare one season with another. Discuss how this affects our daily lives.
- D. Develop a list of precautions people take to protect themselves from ravages of weather, e.g. weather forecasts, evacuations, closing of highways, etc.

CONCEPTS -- Grade 3

VII. Conservation

- A. Water
  - 1. All life must have water.
  - 2. Water has several forms.
    - a. Solid - ice
    - b. Gas - steam
    - c. Liquid - water
  - 3. There are ways to keep water from being wasted.
- B. Soil.
  - 1. Soil is valuable to the production of our life essentials of food, clothing, and shelter.

    2. Soil is sometimes lost but we can save soil.
- C. Forests.
    1. A forest is a community of plants and animals with a predominance of trees.
    2. Forests help build and hold soil and help hold water.
- D. Wildlife.
    1. There are many kinds of wildlife in Pennsylvania.
    2. Wildlife is important to us.
        - a. Birds help man.
        - b. Animals help man.
- E. Minerals.
    1. Rocks are made of minerals.
    2. There are many kinds of rocks.
    3. Weathering breaks up rocks; soil is made partly of weathered rocks.

ACTIVITIES -- Grade 3

VII. Conservation

1. Water: Place a quart jar under a dripping faucet. Discuss uses and needs for water--taking a bath is not necessarily wasting water.

2. Soil: Observe how grass and trees help to keep soil from washing away. Look at area beneath outlet of downspout or where raindrops have hit. Discuss. Examine roots of plants to see how they hold soil. Pour water over sod and over bare ground--Observe--Discuss.

3. Forests: Learn to identify a few trees. Evergreen, deciduous. Mount and label leaves. List uses for wood. Identify roots, trunk, branches of trees. Count rings on a piece of wood. Write to Smokey Bear Headquarters, Washington 25, D. C. for literature.

4. Minerals: Begin rock collections, identify and label them. List minerals and their uses.

Films: Life in the Forest
Rocks
Rocks and Minerals
Treasures of the Earth
Treasures of the Forest
Understanding Our Earth
What Is Soil?

CONCEPTS -- Grade 4

I. Animals

A. Animals that lived long ago are said to be prehistoric.
B. Animals have adapted themselves to climate as well as physical environment.
C. Animals are classified according to important characteristics.
D. Plants and animals are interdependent.

ACTIVITIES -- Grade 4

I. Animals

A. Pupil-teacher discussion of vocabulary terms:
pre-historic, dinosaur, fossils,
Creation of dioramas, models, or murals representative of the prehistoric period.
B. The failure of these pre-historic animals to adapt themselves to their environment caused the animals to become extinct.
Locate climatic zones on the globe.
Children make charts or mural containing the following information:
Animal -
Description -
Size -
Principal Food -
Zone -
Principal Enemies -
Means of Protection -
Other Interesting Facts -
C. Study and classify characteristics of insects, birds, mammals, reptiles, amphibians, fish, crustaceans, and microscopic animals.
The interdependence of plants and animals.
D. 1. Grasses and other plants serve as foods for animals; man, in turn, uses both plants and animals for food.
2. Several varieties of plants are dependent upon animals to spread plants' seeds. (Squirrel-acorn, birds-seeds, etc.)

CONCEPTS -- Grade 4

I. Plants

A. Plants depend on food for growth.
B. Photosynthesis is the making of food in a plant in the presence of sunlight.
C. Only green plants can make food.
D. Plants get their food from soil, water, air, sun, and proper temperature.
E. The flower of a plant produces seeds.
F. The seed contains the baby plant called the embryo.
G. Seeds differ in size, shape, color, and general appearance.
H. Seeds travel by wind, water, and animals.

ACTIVITIES -- Grade 4

I. Plants

A. Parts of a Seed:

Carefully remove the outer coating from a corn kernel and note the parts. Note the small embryo plant and large cotyledon. Examine the embryo under a magnifying glass. Open a lima bean seed, separate the two cotyledons and examine the embryonic plant under the magnifier. Put a drop of tincture of iodine on the cotyledons of the corn seed and bean seed. A blue-black color will indicate that these are composed of starch.

Moisten a piece of blotter paper and lay it on the bottom of a petri dish or similar container. Place a kernel of corn and a lima bean seed on the blotter paper. Place the cover on the dish. Examine the seeds every day until they germinate. Notice the differences between the two kinds of seeds.

B. Seeds absorb water:

Put some dry beans or peas into a small bottle with a screw top. Fill the bottle completely with seeds, shaking and pressing the seeds inside the bottle. Punch a few small nail holes in the cap, and screw tightly. Lay the bottle on its side in a dish of water and let it stand for a day. The swelling of the seeds may break the bottle because of the tremendous force exerted. (Relate to tales about ships that sunk because of the swelling grain cargos.)

C. Is air necessary for the growth of plants?

Soak about a dozen bean seeds in water overnight. Place the same number of beans in about two inches of moist sawdust placed in two fruit jars. Tightly close one with a screw cap, but leave the other open. In a few days, both sets of beans will grow but the set that has been sealed will stop growing when the oxygen within the jar has been partially used. If you continue keeping the sawdust moist, the open jar of beans will continue to grow until all the stored food in the seeds is used.

D. Work of the roots:

Materials: Several large lima beans, shallow, glass dish with a cover, piece of blotting paper to fit the bottom of the dish, large cork.

Moisten the blotting paper in the bottom of the dish. Lay the seeds on the paper. Keep them moist. Cover the dish. Stand the dish in a warm, shady place until the beans sprout. When the roots are about an inch long, take the sprouts out of the dish. Fasten the bean seeds to the top of the cork near the edge. They may be fastened with scotch tape. Put the cork on the blotting paper in the dish. Cover the bottom of the dish with water. Put the cover on the dish. Leave it in a warm place for several days. Did the roots grow toward the water?

Plants need water and minerals from thesoil. Minerals in the soil are dissolved by water to make a soil solution. Each soil particle is surrounded by a film of the solution. Root hairs grow between and around soil particles. They absorb the soil solution. The root hairs on the bean sprouts may be large enough to look like cotton fibers. Root hairs do not extend all the way to the end of the roots. They start a short distance from the root tips. Only the tips of roots grow. As the root grows, new root hairs develop. When you pull a plant out of the soil, the root hairs are destroyed. New ones grow after the plant is transplanted. The plant can get water only through the root hairs.

E. Study the main parts of a flower:

Examine specimens of large simple flowers such as tulips or lilies. Count the stamens and observe how they are arranged about the central pistil. Make large diagrams of the essential organs. Label the parts of the pistil (stigma, style, ovary). Label the parts of the stamen (filament and anther).

The end of the stalk on which the flower grows is called the receptacle. At the base of the receptacle there are usually leaf-like structures that enclose the bud. These are called sepals. Above the sepals there is usually a ring of brightly colored petals called the corolla.

F. Dissecting Simple Flowers:

Label each of five pieces of paper with one of the following words: stamens, pistil, sepals, receptacle. Dissect a flower carefully and place the parts neatly on the appropriate pieces of paper.

Some flowers can be pulled apart quite easily, but a knife or scissors may be needed for others. Simple flowers with a single row of petals should be selected. Pick up one of the stamens and rub the anther lightly across a piece of black paper. Traces of pollen will usually be seen. Cut the ovary crosswise with a sharp knife and count the ovules or "seed pockets". Look for traces of seeds in the ovules.

G. Nature Hike:

Take the children to a nearby wooded area. Observe the plants growing in their natural habitat; ferns and mosses in shaded areas, lichen growing near the base of a tree or on rocks, algae floating on ponds and streams, mushrooms growing on dead material, bracket or shelf fungi on trees, grasses and wild flowers in open spaces, small saplings struggling for light and air in the dense wooded sections, and many other specimens of plant life in their natural settings.

H. Make a Terrarium:

Get a glass tank or a wide-mouth gallon jar. Spread a layer of charcoal on the bottom of the tank. Cover the charcoal with a layer of sand and small stones. Then fill the tank with rich, moist, wood soil. (Wood soil can be made by mixing one part sand with two parts leaf mold.) Make one side and one end of the soil in the terrarium higher to allow deeper soil for larger plants. Put slow-growing plants and sprinkle with water after they are planted. Place a flat piece of glass over the tank or jar.

I. Importance of Plants in our Daily Life:

This activity may be useful in introducing a unit on plants and their importance to man. Without plants, man would not be on earth.

FIELD TRIP: Take children to a supermarket and have them list all plants and plant products. The class may be divided into groups-exp. Group 1 vegetables, Group 2 canned goods, etc.

A chart, as shown below may be used to further explore the world of plants.

This activity may be tied in with geography and social studies. A bulletin board with a map showing the country of origin may be used as a culminating activity.

Product	Name of Plant	Family	Part of Plant Used	Country of Origin	State or Region of U.S.	Misc.

CONCEPTS -- Grade 4

II. Man

A. The Skeletal System
   1. Body bones outline and support the body structures.
   2. Good diet, vitamin "D" and good posture promote good bone structure.
   3. Milk is a necessity for firm bone and tooth health.
   4. Bones are a hard cage protection for brain and lungs.

B. The Respiratory System
  1. We breathe in (inhale) oxygen and breathe out (exhale) CO_2.
  2. Breathing in through the nose warms and filters air to the lungs.
  3. The body cannot survive more than four (4) minutes without an adequate oxygen supply.
  4. Artificial respiration forces oxygen into the lungs.

C. The Circulatory System
  1. The heart is a muscle.
  2. Blood vessels are the tubes which carry blood.
  3. Blood moves from heart to all parts of the body - to the heart again - to the lungs (for oxygen) to the heart and again to the body.
  4. A grown person has about five (5) quarts of blood.
  5. The heart beats faster after vigorous exercise.
  6. The heart beat is slower during sleeping hours.

D. The Glandular System
  1. Glands are specialized parts of the body that send chemical substances into our blood.
  2. Glands determine how fast and how big we grow.
  3. Glands act to make us different kinds of human beings.
  4. Glands make our heart beat faster when we are afraid.

E. The Muscular System
  1. Muscles are attached to bones by tendons.
  2. Muscles move our bony structure by expanding and contracting.
  3. Muscles need protein food and exercise for development.
  4. Posture is determined by muscular training.

F. The Nervous System
  1. The brain receives messages from the senses; sight, hearing, feeling, smiling, and tasting.
  2. We really see, hear, feel, smell and taste with our brain.
  3. Our spinal column is a system of nerves from our brain to all parts of the body.
  4. Our nervous system remembers all that has come to it through seeing, hearing, touching, tasting and smelling.

G. The Digestive System
  1. Digestion of food begins with chewing in the mouth.
  2. The stomach and intestines complete the digestion of food.
  3. Food should look, smell and taste good. This aids digestion.

ACTIVITIES -- Grade 4

II. Man

A. The Skeletal System
  1. Using soft clays have children manipulate and make forms. Then with use of sticks as rigid support note how shapes can be sustained.
  2. Obtain X-ray pictures of bones ricketed by lack of Vitamin D. Compare with X-rays of normal bones.
  3. Let children investigate composition of milk - also composition of bones (teeth) - investigate abundance of calcium and phosphorous in other foods.

   4. Investigate other instances where a tough or hard exterior protects a soft interior - example: eggs, ants, lobster.
- B. The Respiratory System
   1. Have children blow in tubes of lime water. Prepare class to identify cause of cloudiness due to gas CO_2 forming a precipitate.
   2. Let children examine electrical sweeper filters to see amount of dust in air. Discuss need for warm air to the lungs.
   3. Call attention to news accounts of suffocation. Safety lessons on danger of allowing small children to play with balloons, cellophane bags, and discarded refrigerators.
- C. The Circulatory System
   1. Have children try to hold their breath. Notice color of faces. Note heart and chest pressure. Excellent film strips can make this process very vivid.
   2. Have class place hand over heart while standing still. Then running in place for a minute place hand over heart.
   3. Examine chicken, beef or any animal heart. Notice muscle fiber.
   4. Using a stethoscope, have children try to find each other's heartbeat.
- D. The Glandular System
   1. Examine Nystrom anatomical charts or models to locate glands.
   2. Experiment with salivary glands. Determine effect of lemon or pickle on salivary glands.
- E. The Muscular System
   1. Locate tendons on an anatomical chart or models.
   2. Examine chicken legs.
   3. Very dramatic projects can illustrate this concept. Two white mice kept in separate compartments with two separate diets. This requires about one week to ten days. With a small area, deprived of protein food the one mouse will show weight loss, poor muscle tone and walking difficulty. With a larger exercise area and protein food, the second mouse will show the complete reversal.
- F. The Nervous System
   1. Dramatize information received through the sense; color, size and distance through the eyes; various sounds through the ears; heat, cold, texture, and hardness through touch; saltiness, sweetness, bitterness and sourness through taste.
   2. Let children trace connections from sense organs to brain by use of anatomical charts or models.
- G. The Digestive System
   1. Let children recall how chewing breaks and moistens food for swallowing.
   2. How children recall the sour odor of upchucked food. Discuss reason for this. Add vinegar or lemon to milk to show curdling.
   3. Pose situations of varying emotional tone; i.e. - sadness, anger, gladness etc., then suggest favorite food treats. Have several children observe reactions. Discuss personal experiences appropriate to this area.
   4. While taste, smell and appearance are not completely reliable

tests for the purity of foods; it is true that pure foods are more attractive.

CONCEPTS -- Grade 4

III. Energy - Magnets

A. The three kinds of magnets are natural, permanent, and temporary.
B. The three basic forms of magnets are the horseshoe magnet, the "U" magnet, and the bar magnet.
C. The magnetic power of a magnet is stronger as it moves away from the center of the magnet.
D. The affected area around a magnet is the magnetic field.
E. This affected area (magnetic field) is composed of magnetic lines of force.
F. Magnetism goes through some things, but not through others.
G. The earth is a large magnet; so is the sun.
H. The earth has a north magnetic pole and a south magnetic pole different from the north and south geographic poles.

NOTE: Magnetism in Grades 5 and 6 becomes a small part of the section "Electricity."

ACTIVITIES -- Grade 4

III. Energy - Magnets

A. Magnetic attraction:

Dip a bar magnet and a U magnet into a dish containing assorted objects of various materials. List below the objects which the magnet attracts and those which it doesn't. When possible indicate the material.

ATTRACTED		NOT ATTRACTED	
Object	Material	Object	Material

B. Using objects which the magnet attracted, test the various parts of the magnet to discover where the attractive force is greatest and where it is least. Repeat using a piece of lodestone. (In Addition, determine how many centers of attraction are present in the piece of lodestone you are using.

C. Magnetic Poles:

Approach the north marked end of a magnet free to pivot with the north marked end of another magnet. Observe what occurs. Repeat using the south ends of both magnets. Repeat once more using the north end of one magnet and the south end of the other.

D. Theory of Magnetism:

Test a needle for magnetism by dipping it into a dish of small nails or iron filings and by checking it with a compass. If some magnetism is present, make a mental note of the strength by observing how many nails or how much filings the needle picks up. Then stroke the needle from one end to the other end with one pole of a bar magnet. Do this 20 times always stroking in the same direction. Retest the needle for magnetism with nails or filings and with the compass.
Using two pairs of pliers, firmly grip each half of the needle near the center and break it in two. Test each of the two pieces for magnetism, checking the ends and middle portions. Break one of the halves of the needle again and test each piece.
Heat the remaining half needle to redness in a flame. Be sure to heat it over its entire length. Let it cool. Test again for magnetism.

E. Magnetic field:

Place two rulers (or equivalent) in a parallel position about six inches apart. Place a bar magnet in a horizontal position midway between the rulers. Over all, place a piece of paper or thin cardboard.

F. Sprinkle iron filings lightly and evenly from a height of about six inches above the paper. Tap the paper lightly with a pencil until a distinctive pattern emerges in the filings. To preserve the pattern spray the paper with "Spray Dope" (fixitive which can be purchased in hobby shops). Repeat above using two bar magnets in a line with the two northpoles about an inch apart, and having the two unlike poles about an inch apart.

G. Place various materials between a magnet and a spike to see if magnetism will pass through the material. Keep records.

Substance Between Magnet and Spike	Thickness	Observed Effect
Glass		
Air	¼" - ½"	
Wood		
Nickel		
Copper		
Aluminum		
Iron		

H. Discuss the proper care and use of magnets. Bar magnets should always be stored in pairs with the N end of one next to the S end of the other. It is advisable to place a "keeper" (ie. soft iron bar or nail) across the ends of the stored pairs to insure the longest and best retention of magnetic strength. Horseshoe and U-shaped magnets should also have keepers placed across their poles when not in use. Compasses should not be stored near to magnets.

Magnets should not be brought close to watches as this can result in damage to the mechanism.

CONCEPTS -- Grade 4

III. Electricity

A. Lightning is a form of frictional electricity.
B. Frictional electricity is produced when certain things are rubbed together.
C. There are two kinds of charges of frictional electricity--negative and positive charges.
D. Electricity moving through wires or other conductors is called current electricity.
E. Any substance through which an electric current can pass is called a conductor.
F. Current electricity does most of our electrical work.
G. Metals such as silver, copper, aluminum, and iron are good conductors of electricity.
H. Some substances are nonconductors of electricity.
I. A switch is placed in the circuit so that the flow of electricity can be turned on or off.
J. Electricity can be used in hundreds of different ways.
K. In order for an electrical current to flow, there must be a complete circuit from the source to the object using the electrical current and back to the source again.
L. When electricity is caused to flow through a coil of wire wound around a piece of soft iron, a magnetic field is formed. This is called an electromagnet.
M. Unlike other magnets, an electromagnet can be turned on or off at will.
N. Electromagnets have many uses.

ACTIVITIES -- Grade 4

III. Electricity

A. Frictional Electricity. Tear a small piece of paper into tiny bits. Rub a rubber comb or rod, or a plastic comb or rod, with a piece of woolen cloth. Bring the comb or rod near the bits of paper and observe what happens. Go to a water tap. Turn it on just enough to allow a fine stream of water to flow from it. Put an electric charge upon the comb or rod. Carefully bring it near to the fine stream of water. Observe what happens to the stream of water. Let the comb or rod touch the stream of water for a minute and observe what happens.

B. Frictional Electricity. Blow up two round rubber balloons. Tie a string on to each balloon. The string should be about two feet long. Let two pupils hold a yardstick on each end. Tie the two balloons to the yardstick. The baloons should hang down about two feet and should be only two inches apart. Rub each balloon on a piece of woolen cloth. Let them hang down again. Observe if they swing together and stick or if they seem to push each other away? Bring a charged rubber rod near one of the balloons. Repeat with a glass rod charged with a silk cloth. Observe what happens.

C. Use a metal pie plate for a base, turning it upside down upon a desk or table top. Upon the pie plate, place some fine bits of paper, bits of cork, flakes of sawdust, short pieces of thread, tiny bits of cellophane--colored cellophane if possible. Bring a charged comb or plastic rod near the material and watch some of it jump back and forth, bounding from the pie plate to the plastic rod or to the comb and then back to the pie plate again.

D. Pithball Electroscope. Get a glass bottle as shown in the diagram. Bind a short piece of wire, making a little hook on the curved end of the wire. Stick the wire into a cork and push the cork into the bottle. Two pithballs will be needed. (Most science closets are stocked with pithballs, however, substitutes can be used. They can be cut from the center of a dry cornstalk, or grains of puffed wheat can be used.) String the two pithballs on each end of a silk thread and hang them over the wire hook. Rub a plastic or rubber rod or comb with wool to charge it with frictional electricity.

E. Using a dry cell, insulated wire, and a buzzer, bell, or light, make a simple circuit. Add a switch to the circuit.

F. Discuss the use of switches. Examine the inside of a push button and learn how it makes and breaks a circuit. Examine a knife switch and see how it makes and breaks a circuit. Have the children make their own switches.

G. Examine an electric light bulb. (If the glass is frosted, wrap with a cloth and break gently.) Discuss the importance of the tungsten filament.

H. Using a simple circuit as described in activity number 9, test various materials for conductors and nonconductors. Lay the material to be tested across the two poles of an open knife switch. If the bell rings or the lamp lights, the material is a conductor.

I. Electromagnet. Construct an electromagnet. Wind 10 to 30 turns of wire around an iron rod. Connect this to a dry cell. (The more turns the stronger the magnet.) Test the electromagnet's attraction with various materials. Add a switch to the circuit. (Do not leave the switch closed any longer than necessary.)

J. Examine an electric motor to see the role of an electromagnet. Better students can construct a simple motor.

K. Examine a door bell or buzzer to see the role of the electromagnet.

L. If your school is located in the Bethlehem Steel Company vicinity, a walk along Daily Avenue will be profitable in seeing huge electromagnets in operation.

M. A committee may be set up to give a report about Ben Franklin and his work in electricity.

CONCEPTS -- Grade 4

III. Energy - Light

A. Light comes to us from the sun and other incandescent substances.
B. Man has used many kinds of fuel for lighting.
C. Light travels in straight lines.
D. Light travels through some materials and not through others.
E. Light can be reflected.
F. Smooth light colored things reflect the most light.
G. Dark objects absorb a lot of light.
H. Light bends when it passes from one material to another (eg. air to glass). Prisms bend light this way.
I. Light and color are related. There could be no color without light.
J. The spectrum is a band of colors blending into each other that make up white light.

ACTIVITIES -- Grade 4

III. Energy - Light

A. Collect series of pictures showing the progress of our methods of lighting - early torches, whale - oil lamps, candles, gas, kerosene, electricity, etc.
B. Make candles from margarine and any other solid cooking fat. Fill a saucepan with water to a depth of $\frac{1}{4}$ inch. Put margarine into a jar cover and insert it into warm water. After the margarine melts, remove the jar lid from the hot water and permit the loose end of a string to rest inside the melted margarine. The string will serve as a wick when the margarine hardens. Experiment with the string to see how long it should be to serve as a wick.
C. Punch a hole in the center of a piece of cardboard that is about one foot square. Hold the cardboard in an erect position in front of a film-strip projector. Children can note that light can be observed only along a straight line extending from the projector through the hole.
D. Collect variety of materials to test how well they reflect light. Use smooth, rough, light and dark objects.
E. Select and test different kinds of substances to find out whether they are transparent, translucent, or opaque. Test the substances by holding them in front of a strong light.
F. Light can be reflected:
   1. Let the children experiment with mirrors on a sunny day. Send beams of sunlight to a corner of the ceiling, to the chalkboard or any place the children choose. Also try using light from a filmstrip projector or a flashlight.

G. Study reflection from a floor or wall by bouncing a rubber ball straight and at angles from the reflecting surface. Observe and compare the angle at which the ball strikes the surface with the angle at which it is reflected.
H. Construct a simple periscope using a cardboard or milk carton. Place a mirror at a 45degree angle at the top and bottom of the carton.
I. Place a piece of white paper and a piece of black paper side by side on a table. Darken the room. Using a flashlight or filmstrip projector, point a light on the black paper and notice the amount of light in the room. The white paper will reflect more light. Experiment with papers of different colors. Try using both rough and smooth surfaces.
J. Place a coin in a pan and have a student stand at a position so that he cannot see the coin below the rim of the pan. Add water to the pan and the coin will become visible. This illustrates refraction of light.
K. Darken the room. Hold a prism in the path of a ray of sunlight and turn the prism slowly until you see a rainbow on the wall or ceiling.

CONCEPTS -- Grade 4

III. Energy - Sound

A. It takes energy to create sound.
B. Sound is caused by vibrating objects.
C. The vibrations caused by energy and moving objects are transmitted through liquids, solids, or gases to reach the ear.
D. High and low sounds are a result of the number of vibrations per second.
E. High sounds are caused by rapid vibrations.
F. Low sounds are caused by slower vibrations.
G. Sound waves travel through the atmosphere to the ear.
H. Sound travels slower than light.

ACTIVITIES -- Grade 4

III. Energy - Sound

A. Pluck the string of an instrument.
B. Touch your throat and start to speak.
C. Strike a tuning fork, place the base on a solid object.
D. Strike a tuning fork, place the base in a pan of water.
E. Stretch a rubber band and pluck it to see vibrations.
F. Discuss how Indians put their ear to the ground to hear how far away their enemies or animals were.
G. Have someone talk, and have the person talk with hand cupped over mouth.
H. Drop pebbles in a pan of water to show how vibrations travel in all directions.

CONCEPTS -- Grade 4

III. Energy - Heat

A. Heat comes to us from the sun, from fire, electricity and friction.
B. Heat travels in a straight line through the air.
C. Heat can be directed or aimed at an object.
D. Heat is carried better by metals than by many other materials.
E. Some metals carry heat better than others.
F. By adding or taking away heat, water (liquids) can be changed into steam (gas) or ice (solid).
G. Dark surfaces absorb heat more rapidly than bright surfaces.
H. Warm air travels upwards.
I. Heat causes evaporation.
J. Evaporation has a cooling effect.

ACTIVITIES - Grade 4

III. Energy - Heat

A. Hold a magnifying glass and focus the rays of the sun to a point on a sheet of paper.
B. Place a thermometer on a table. Then set a lighted candle a foot away from the bulb of the thermometer. Observe if the temperature goes up. Now place one half of a bright tin can near the candle so that the candle is between the can and the thermometer. Observe what happens to the temperature reading now.
C. 1. Hold pieces of wire made of various metals such as aluminum, copper, and iron in candle flame. Observe if the ends of the wires you are holding become hot in the same length of time.
   2. Some schools have conductometers composed of copper, aluminum, and brass rods. Use this apparatus to see which metals conduct heat better.
D. Place the bowls of spoons made of such materials as aluminum, silver, tin, iron, glass, wood, and plastic in a pan of water. Place the pan of water on a hot plate. Carefully touch the handles of the spoons as the water heats. Observe which handles heat first.
E. Heat travels by radiation. To show the effect of radiant energy on light-colored and dark clothing, place two thermometers in the sun. Place a square of white cloth over one and a square of black cloth over the other.
F. Different kinds of surfaces affect radiation. Obtain a quart jar which has an opening large enough to allow a small light bulb to enter. Measure and mark off the jar into six equally sized segments extending from the top to the bottom. Paint the two opposite segments with black paint, the next two with white paint, and the last two with aluminum foil (attach with glue). Attach to each segment with wax a small nail (tacks, coins, matchsticks or other light weight objects may be substituted). Lower the light bulb in the jar and observe the order in which the objects fall off.
G. Warm air travels upward. Hold a paper windmill over and above a

heat source - a radiator, lamp, candle. Hot air currents will turn the blades when the heat is allowed to come from beneath one side of the windmill.

H. Evaporation:

Pour small but equal amounts of water in each of two pans. Place the pan over a heat source. Allow the other pan to remain at room temperature. Observe and compare the loss of water in each pan. Discuss how streets dry rapidly in summer and slowly in winter after a rain.

I. Evaporation has a cooling effect. Put a drop of water on a saucer and a drop of alcohol in another. Place on the same saucer and notice which disappears first. Now put a few drops of water on the back of one hand and the equal amount of drops on the other hand. Compare how each of the hands feel. As the liquid evaporates, heat is taken from your hand. Alcohol evaporates more rapidly and therefore will feel cooler. Discuss how windspeeds up evaporation - relate to experience of coming out of a swimming pool and feeling cool.

J. Discuss how heat is used in making steel at the Bethlehem Steel Company.

K. Get an empty anti-freeze can at a garage or filling station. Read the directions on the can and discuss the purpose of anti-freeze in an automobile.

L. Discuss how heat is used in the following: cooking and baking, refining oil, making sugar, making glass.

CONCEPTS -- Grade 4

III. Nature of Matter

A. All substances are chemicals.
B. All matter is made up of molecules.
C. Molecules are in constant motion.
D. Non-living things are classified as a solid, liquid or gas.
E. Physical and chemical changes are taking place all the time.
F. All chemicals can either be acid, base, or salt.
G. Acids and bases can change the color of certain chemicals known as indicators.
H. Energy is needed in order that physical or chemical changes may take place.
I. There are many kinds of energy.

ACTIVITIES -- Grade 4

III. Nature of Matter

A. Molecules:

1. Place a glass of water where it will not be moved. Let it stand for an hour. Without moving the glass, gently put a

drop of vegetable coloring in the water. Observe how the motion of molecules slowly spreads the coloring through the water.

2. Pour a little ammonia into a flat dish at one end of the room. See how much time passes before all the students can smell the ammonia.

B. Show water in its three states -- solid, liquid, gas. Change from one state to another.
C. Test various materials for acidity and alkalinity. Use litmus paper, or purple cabbage juice.
D. Discuss physical and chemical changes taking place all around us -- rusting, evaporation, condensation, decaying, melting, freezing, etc.
E. Perform experiments to show physical and chemical changes.

1. Physical Changes:
   a. Fold a square of paper into accordion pleats. Compare the properties of the folded square with those of the flat one. The pleated square is springy. The pleated square can support the weight of a light book. Although the paper itself does not change, the folds change it physically to give it added strength.
   b. Soak a square in water. Compare what happens to a wet square and a dry square when they are pulled. The wet square tears more easily than the dry one. Although the paper itself does not change chemically, the water changes the paper physically to weaken it.
   c. Dissolve salt in a glass of water. Discuss how the salt has changed. Let the glass stand in a warm place for several days. Observe what happens.

2. Chemical Changes:
   a. Put a few iron nails in a glass. Pour a small amount of water over the nails. Do not completely cover the nails with water and do not cover the glass. Set the glass aside but look at it from time to time. As the water evaporates, add a little more. See how long it takes for signs of rust to form on the nails. Try the same experiment using painted nails.
   b. Fill a test tube or aluminum cup about one-fourth full of sugar. Heat and watch what happens. After the white sugar has turned black, let it cool and taste it. It will no longer taste sweet.
   c. Pour vinegar over baking soda and observe what happens. Hold a match over the bubbles. Carbon dioxide is formed. Test the vinegar with litmus paper before and/after the chemical reaction.
   d. Set fire to a crumpled square of paper in a pie plate or on a piece of aluminum foil. As the paper burns, light, heat, and smoke are given off. Most of the white paper vanishes, leaving behind a crumbly ash, some black material, and

possibly some unburned areas where the paper was in contact with the metal surface.

e. Discuss how chemists have been able to make many new substances by learning how chemical changes occur -- clothing, plastics, medicine, etc.

F. Acids, bases, and salts:

Test for acids and bases using purple cabbage juice and litmus paper. (Acids turn blue litmus paper pink; alkalis turn pink litmus paper blue.)

G. Filtering Water:

Punch little holes in the bottom of a milk carton. Pour about 3 inches of fine gravel in the carton. Add 3 inches of sand on top of the gravel. Rest the carton on a glass and pour muddy water on top of the sand. Let it filter through.

H. Killing germs in water:

Get some stagnant water from a quiet pool or ditch. Use the microprojector or microscope to see if there are any microscopic animals swimming around in it. Add a few drops of bleaching water (contains chlorine). Observe what happens to the animals.

CONCEPTS -- Grade 4

IV. Machines

A. By using machines people can make their work easier.
B. Simple machines are machines with few, if any moving parts.
  1. A lever is a pole or bar working on a support. (hammer, nutcracker)
  2. A wheel and axle is a rod to which a wheel is firmly attached. (crank, steering wheel on a car)
  3. A block and tackle is an arrangement of a rope and pulleys. (scaffold, used to set up tents)
  4. A wedge is a piece of metal or other material thick at one end and thin at the other. (ax, scissors)
  5. The screw is a metal device shaped like a nail with threads at one end and a head with a slot at the other. (nuts and bolts, propeller)
  6. The inclined plane is any slanted surface. (hill, stairway)
C. Large machines are machines which are made up of two or more simple machines working together.
D. Some things are hard to move because of friction.
  1. Friction cannot be eliminated but can be reduced by: (wheels and rollers, oil and grease)

ACTIVITIES -- Grade 4

IV. Machines

A. Gather pictures illustrating people using machines.
B. Make a collection and classify simple machines in ordinary household equipment. (hammer, egg beater, etc.)
    1. Use construction toys to make models such as an inclined plane with a toy car to ascend and descend it.
    2. Make drawings of simple machines.
    3. Take a field trip to observe simple machines in action such as construction work or house building. After the trip pupils can write a paper to describe the application of the simple machines.
    4. Make posters to show the application of simple machines.
    5. Make a scrapbook from magazine pictures in six sections, one section for each simple machine.
    6. Six boxes labeled for each of the simple machines could be placed about the room and simple tools, toys, and other devices could be placed in the boxes as children find applications of simple machines and bring materials from home.
    7. Use the seesaw on the playground to illustrate the lever.
    8. Make pulleys by using empty spools supported by a wire framework.
    9. Make an inclined plane with planks and pull up a loaded wagon.
C. Visit nearby construction site to see power machines at work, observing the many simple machines which are involved in one large machine.
D. 1. Use broom handles under a box loaded with rocks to decrease friction.
    2. Pull the same box without rollers to show the difference.

CONCEPTS -- Grade 4

V. Earth and Universe - Structure

A. The story of the earth may be seen in rock.
B. Man uses minerals that are found in rock.
C. Broken-up decayed vegetable and animal matter.
D. The top line of water in the soil is called the water table.
E. Swamps are places where underground water is very close to the surface or slightly above it.
F. A lake is formed where the water table is above the surface of the land.
G. In a desert the water table is very far below the surface.
H. Water can be found almost anywhere in the world if we dig deep enough.

ACTIVITIES -- Grade 4

V. Earth and Universe - Structure

A. Invite geologists from nearby colleges or universities in to talk on rocks and minerals.
B. Investigate public buildings to see the uses of rocks and minerals. (Limestone - mortar - sandstone, etc.)
    1. Identify local rocks used in construction.

C. Get two pieces of sandstone and grind them together. Examine the resulting grains of sand through a magnifying glass. Examine soil. Sift soil through a coarse strainer to separate coarse particles and pebbles from finer soil.
D. Visit a nearby cave where rock collections may be seen (Crystal Cave, Lost Cave) as well as water table.
E. Look at pictures of different places on the earth - seashore, deserts, mountains, swamps. Tell how the places are different from each other. (rough, smooth, wet, high, rocky, etc.)
F. Find by experimentation which soil material will hold the most water. Cut tops and bottoms from 4 tin cans. Tie a piece of cheesecloth (double thickness) over the bottom of each can. Put equal amounts of each kind of soil - sand, clay, and humus in separate cans. For the fourth can mix equal parts of the three kinds of soil together. Secure four larger containers that will hold water and support each of the cans containing samples over one of the larger containers. Pour equal amounts of water into each top can. Measure the amount of water that seeps through each sample after 5, 15, and 30 minutes.
G. Locate a well-driller to furnish samples of different soils and rock formations from under-ground and for information about water level.

CONCEPTS -- Grade 4

V. Earth and Universe - Movements of Earth and Moon

A. The earth rotates on its axis once every twenty-four hours.
    1. The axis is an imaginary line from the North Pole through the center of the earth to the South Pole.
    2. The earth is tilted on its axis.
    3. The slant of the axis remains the same as the earth travels around the sun.
B. The earth travels in its orbit revolves around the sun once every 365¼ days. That period of time is called a year.
C. These two motions of the earth go on at the same time.
D. The moon is a lifeless ball of rock, without water or air, revolving and rotating around the earth.
E. The earth's gravity pulls the moon and helps to keep it circling around the earth.
F. The moon travels around the earth about once every four weeks.
G. Sunlight reflected from the moon is called moonlight.
H. Although the moon is a quarter of a million miles away, its gravity pulls on the waters of our oceans.

ACTIVITIES -- Grade 4

V. Earth and Universe - Movements of Earth and Moon.

A. Demonstrate movements of the earth and moon with the Trippensee Planetarium.
B. Recall the trip of the rocket Ranger to the moon. If possible secure newspaper pictures of the trip. Discuss the findings.
C. Demonstrate the moon's revolution by setting up a light (sun) and

having two balls of different sizes represent earth and moon. Carry the moon around the earth for the children to observe how light from the sun reflects from the moon.

D. Paste a small mirror on a ball to represent the moon. Shine a flashlight (sun) on the mirror to show how the moon reflects light. Feel the mirror to see if it is warm.

CONCEPTS -- Grade 4

V. Earth and Universe - Beyond the Earth

A. The members of the solar system we know best are the earth, the moon, and the sun.
B. Some planets have one or more moons, while others have none.
   1. Each is held in its orbit by the sun's gravity.
   2. Together with the sun, they make up the main parts of the solar system.
C. To travel in space, you would have to get beyond the pull of the earth's gravity.
D. Other planets, like the earth, travel around the sun.
E. Some are farther away from the sun than the earth and others are nearer the sun.
F. There is little likelihood that there is life as we know it, on any other planet than the earth, except perhaps Mars.

ACTIVITIES -- Grade 4

V. Earth and Universe - Beyond the Earth

A. Draw a circle on the blackboard a quarter of an inch across. Beside it make another circle twenty-seven inches across. The sizes of these circles show how much larger the sun is than the earth.

B. To see why the earth keeps rolling along in the same path. Get a ball and attach a strong rubber band to it. Now whirl the ball round and round over your head. The harder you whirl, the farther out the ball goes, until finally it will go no farther. Notice that when it is going at the same distance from your head. When you whirl the ball, there is a force that pulls the ball away from your hand. At the same time the rubber band is pulling the ball in toward your hand. So there are two forces, one pulling the ball out and one pulling it in. The ball will move out no farther when the pull of the rubber band on the ball is just equal to the force that pulls the ball out. It will stay whirling in this path.
Materials: ball and rubber band.

C. To explain why certain planets appear brighter than others darken the room. Hold a sheet of white paper close to a lighted bulb or flashlight. Move the paper farther and farther away from the light. How does the brightness of the paper change? How does this explain the fact that Mercury appears much brighter than Saturn?
Materials: white paper, flashlight.

D. Encourage children to watch the sky. They can note changes in the sky even during short intervals. Make them aware that the statement, "The sun is not shining when it is cloudy," is not true. Supporting evidence to refute this statement may be gained from observation of the sky. Some children may have had the experience of having flown in an airplane and finding the sun shining above the clouds.

E. To explain the difference in temperature of different planets turn on a bright electric lamp without a shade. Hold a thermometer two feet away. Keep it there for two minutes. What temperature does the thermometer show? Repeat the experiment at a distance of one foot. Then repeat it at two inches. How does this experiment help to explain the temperature of Pluto, Earth, and Mercury?
Materials: lamp, thermometer.

F. Show the children how shadows are made. Place various objects between the sunlight or an electric light and the children to show how shadows are made. Let the children form shadows. Show them that shadows are made by clouds. On foggy days let them examine the fog, which is a cloud near the earth. The fog casts a shadow on the earth and makes it darker.

CONCEPTS -- Grade 4

VI. Air, Weather, and Climate
- A. Air has weight and occupies space.
  - 1. Air expands and becomes lighter when heated.
  - 2. Air contracts and becomes heavier when cooled.
- B. Molecules of water vapor form clouds in the sky that bring precipitation.
- C. Water does not heat up as quickly as land.

ACTIVITIES -- Grade 4

VI. Air, Weather, and Climate

A.
1. Place a little water in a clean gallon can. Heat it until it steams for a few minutes. Quickly put the top on the can and pour cold water over the can. The pressure should cave in the sides of the can.
2. Have children experiment with suction cups. They should see that the air pressure is holding it against the wall and not sticking to it.
3. Put a balloon over the neck of a flask and place it over a candle. The heated air should cause the balloon to inflate.
4. Cool the flask. The balloon should deflate as the air is cooled.
5. Blow smoke into a cold jar and place a heated jar over it with the openings together. Invert in a few seconds and the cooled smoke will move to the bottom of the jar, forcing the warmer air upward.
6. Blow up a toy balloon and secure end with string. Tie it to a radiator or near heat. Observe. Then put the balloon on ice or in a cold place. What happens now?
7. Make a fountain using a length of glass tubing, one end of which

has been drawn to a fine point, and a one-hole rubber stopper that fits a jar or flask. Other end of tube should be near the bottom of jar which is about one-third filled with water. Blow into pointed end of tube. Why does a fountain of water begin?
8. Fill a glass with water. Hold a piece of paper firmly over the top and turn the glass upside down. What happens? Slowly slide the paper. What happens now? What holds the water in the glass?
9. Use an empty jar having a tight-fitting lid with one hole punched near the rim. Fill the jar with water and place the lid on jar. Invert jar. Does the water flow out? Now punch a second hole opposite the first. Invert again. Does the water flow out now? Why? Place your finger over one hole. Why does the water now stop flowing? What holds the water in the jar?
10. Put a small piece of paper in a dry milk bottle. Peel a hard-cooked egg. Set fire to the paper in the bottle. Quickly place egg in neck of bottle. Why does egg seem to "dance" a bit on the neck of bottle? Why is egg pressed into bottle? Tilt bottle upward and blow with force into bottle. What forces egg out of the bottle?

B. Use a cloud chamber to show how clouds form.
C. Place two dishes of water and dirt in the sunlight for a length of time. Place a thermometer in each and record the temperature of each. The water should have the lower temperature.

CONCEPTS -- Grade 4

VII. Conservation (water)

A. The primary source of pure fresh water is rain, snow, sleet or hail.
B. Water has several forms (solid - ice; gas - steam; and liquid - water).
C. All life must have water.
D. We use water in everyday living.
E. Water is used by plants in making food.
F. Water is for pleasure.
G. We sometimes waste water.
H. Water is our most abundant resource.
I. Water is necessary for all life.
J. Fresh water is a daily "must" for human life.
K. The constant movement of water from clouds to earth and back again is called water cycle.
L. Your health is dependent on clean water.

ACTIVITIES -- Grade 4

VII. Conservation

A. Discuss how precipitation falls to the ground, soaks in, runs off, or evaporates and condenses to form clouds.
B. 1. Bring a piece of ice to the classroom and watch it melt. Discuss what ice is.

2. Heat water over a bunsen burner and watch the steam. Hold a cold piece of glass over the steam and note the condensation. Discuss what steam is and some of its uses at home, school, and in factories.

C. 1. Place a sweet potato in water. Note that the roots and leaves grow. Have a control.
   2. Place an acorn in a glass with water and watch the roots and leaves grow. Have a control.
   3. Make a list of things that need water to live.

D. 1. Have the class suggest ways in which we use water. List these on the bulletin board and bring in pictures to illustrate.
   2. Have class discussion of use of water for personal cleanliness. Have the class list ways in which water is used at school.

E. Have children list foods they ate for one day's meals and tell about the use of water in producing each of them.

F. Have children tell of ways they can enjoy water: snow-balling, skating, swimming, boating, camping near water, cool drink, fishing, bathing, skiing, going to parks.
   1. Have children tell of waterfalls, lakes, ponds, and rivers they have visited.
   2. Have children draw pictures of the rainbow. Tell them the rainbow is caused by the sun shining through rain; the water separates the sun's rays into different colors.
   3. Have children bring in post cards or pictures showing Pennsylvania water scenes.

G. 1. If there is a leaky faucet, place a quart jar under it and see how soon it fills. Then discuss how much water is wasted in 24 hours from a leaky faucet. Multiply this amount by the number of homes in your area to see how much water would be wasted if there was one leaky faucet in each home.
   2. Talk about other ways in which we waste water.

H. 1. On an outline map of the world show with blue crayon the parts of the earth's surface covered with water.
   2. On an outline map of Pennsylvania show with blue crayon the major streams and rivers. A fine stream map of Pennsylvania showing all its streams is available from theDept. of Property and Supplies, Division of Documents, 10th and Market Streets, Harrisburg. (25¢)
   3. List sources of water used in your community. Don't forget brooks, creeks, wells, springs, ponds, and lakes. Note where the water flows: to the Chesapeake Bay, to the Mississippi, to the Gulf of Mexico.
   4. Find out from pupils how many homes have wells or springs. Bring out the fact that there is water under the ground at varying depths. This is called the Ground Water Table.

I. 1. Have students make a list of living things, both plants and animals, that use water.
   2. Plant peas or beans in two pots containing identical topsoil. Keep the one damp by regular watering, but allow the other to dry out. Note what happens to the plants.

J. Discuss uses of fresh water:
   1. People must have water to drink, cook, and wash.

2. Farmers use it for crops.
3. Shippers and merchants must have fresh water (including ice) to keep produce fresh in transit, in storage, and on display.
4. Packers must have fresh water for washing and processing fruits, vegetables, and other foods.
5. Manufacturers of countless products must have water.
6. Discuss important of water in blood (70%). Body must have water.

K. 1. Have students trace the water (or hydrologic) cycle:
   a. Precipitation; b. Evaporation; c. Transpiration; d. Condensation.
   2. Make a chart or drawing of the water cycle.
   3. Find the average yearly rainfall for your area.

L. 1. Keep a record of all the ways water is used in your community.
   2. How does your community dispose of sewage?
   3. Visit your water supply system and/or your sewage disposal plants.
   4. Learn about stream pollution.

CONCEPTS -- Grade 5

I. Animals

A. Some animals are hatched from eggs. Others are born alive.
B. Cold blooded animals have variable body temperatures; warm blooded animals have constant body temperatures.
C. Some animals take care of their young for a long time; others not at all.
D. People have found ways of improving the breeds of animals.

ACTIVITIES -- Grade 5

I. Animals

A. Select and attempt to hatch as many kinds of eggs as possible. (be careful of state laws.)
List animals born alive.
B. Attempt to control temperature in order to observe activities of cold blooded animals.
C. Contrast the length of time that human babies need care as compared with animal babies.
D. Explain why scientists attempt to improve the various breeds of animals. (Beltsville Hogs and Turkeys.)

CONCEPTS -- Grade 5

I. Plants

A. Plants get their food from the soil, water, air, sun, and proper temperature.
    1. Roots absorb minerals and water from the soil.
    2. Stems carry minerals to the leaves.
    3. Leaves manufacture food by use of sunshine.
B. Plants that produce seeds have flowers.
    1. The petal of the flower attracts insects.
    2. Insects help pollinate flowers.
    3. Sepals protect buds and support the petal.
    4. Steamen are so formed so pollen drops on the pistil.
    5. The pistil is the female part of the flower.
    6. The ovary is the enlarged region at the base of the pistil.
C. New plants are produced in different ways
    1. seeds 2. runners 3. bulbs 4. leaves 5. roots 6. grafting or budding 7. stem
D. Plants without chlorophyll cannot make their own food.
    1. Some plants depend on other plants for their food - molds, mushrooms, smut, mildew.
    2. Ferns and mosses reproduce by spores.
    3. Flowering plants reproduce by dividing cells, spores, yeast.
E. Lowest plant life is the algae (one cell).
F. Yeast ferments in contact with starches and sugars under proper temperatures produces CO_2.

ACTIVITIES -- Grade 5

I. Plants

- A. Favorable conditions for plant growth:
  - 1. Sunlight
    - a. Place two plants - one in dark closet and one near window - later compare.
  - 2. Water
    - a. One plant watered carefully, one without water - later compare.
  - 3. Soil
    - a. Plant seeds of corn, beans, lettuce in two flower pots: one pot poor soil, good soil in the other, later compare.
  - 4. Heat
    - a. Plant seeds in good soil in three containers, keep two in a warm place, the other one in a cool place - later compare.
- B. Where do plants come from?
  - 1. Seeds
    - a. Plant different kinds of seeds.
  - 2. Runners
    - a. Plant strawberry plants. Start new plants with runners.
  - 3. Bulbs
    - a. Cut open an onion to show new plant inside.
    - b. Set onion in water to show root development.
    - c. Plant different flower bulbs.
  - 4. Leaves
    - a. Try to grow a new African Violet from a new leaf.
    - b. Use different flower leaves.
  - 5. Roots
    - a. Use potato eyes and try to grow plants.
    - b. Place a sweet potato in a jar of water.
  - 6. Grafting or budding
    - a. Show by drawings how grafting and budding are accomplished.
  - 7. Protection from enemies
    - a. Examine cactus, roses, nettles.
    - b. Examine specimens of ferns to see spores.

CONCEPTS -- Grade 5

II. Man

- A. The Skeletal System
  - 1. Bones are the rigid support of the body.
  - 2. The skull protects the soft delicate brain tissue.
  - 3. The rib cage protects the vital heart and lung organs from injury.
  - 4. The ball and socket design of hip and shoulder permit circular movement of arms and legs.
  - 5. Hinge type joints of elbow and knee allow movement in one direction only.
  - 6. The backbone, consisting of many small bones, houses the spinal

cord and provides for the many bending and turning positions of the body trunk.

7. Good posture from childhood plus proper foods (including Vitamin D) are essential to a healthy, proper functioning bony system. (Proper foods containing calcium and phosphorus).

B. The Respiratory System
1. Inhaling and exhaling are the two movements of respiration.
2. The function of breathing is to supply vital oxygen for the body's life and throw off the body's waste gas, carbon dioxide.
3. The path of air to and from the body involves the organs of nose, throat, bronchial tubes and lungs.
4. The rate of breathing varies according to the amount of oxygen needed by the body.
5. Any obstruction or infection of the respiratory organs endangers the body's oxygen supply.
6. Air pollution which alters the normal air composition is a threat to the body because it produces respiratory diseases.

C. The Circulatory System
1. Blood carries food and oxygen to every part of the body to supply cells for the job of growing and repairing tissue.
2. Circulation of blood is carried on by heart arteries, veins and capillaries.
    a. The heart is a sturdy four chambered muscle which acts as a pump.
    b. It receives blood with a fresh oxygen supply from the lungs and pumps it through the arteries to all parts of the body.
    c. It receives blood through veins containing waste, carbon dioxide and pumps it to the lungs to shed carbon dioxide and acquire a fresh oxygen supply.
3. The heart's rate of pumping (number of beats per min.) varies with the amount of oxygen needed by the body.
4. Bleeding occurs when there is a break or cut in any of the system's blood vessels.
5. As a part of the body's defense against loss of blood the process of clotting seals the break except for large cuts where stitches would be required.
6. Blood transfusions are used to maintain the needed amount and composition of blood until the body can produce an adequate supply.

D. The Glandular System
1. Glands are clusters of special cells that manufacture a certain substance and send it into the blood stream.
2. The pituitary gland stimulates growth until the age of twenty-one. It has other functions.
3. The activity of the thyroid gland decides how active the body is to be.
4. Adrenal glands urge the heart to speed its beating.
5. Action of glands is only one of the things that make human beings all different kinds of persons.
6. Glands work as a system (not independently) to regulate much of the body's activity (with regard to rate.)

E. The Muscular System
   1. Bundles of special cells called muscles are capable of contracting and relaxing are attached to the skeleton so that movement may be coordinated.
   2. Muscles can be strengthened by exercise.
   3. Protein foods are necessary for good muscle tone.
   4. Exercises involving abdominal muscles are important in developing a strong protection over soft areas unprotected by bony coverings.

F. The Nervous System
   1. The brain communicates with all parts of the body through a network of nerves branching out from the central nerve called the spinal column.
   2. Light, color and shape of objects are interpreted by the brain from messages arriving from the optic nerve of the eye.
   3. Sounds are interpreted by the brain from impulse sent through the auditory nerve.
   4. Odor is translated by the brain from messages received via the olifactory nerve.
   5. Reaction time refers to the interval between the time the stimulus reaches the senses and action is commanded to the appropriate organ of the body.
   6. Breathing and heart action are governed by an involuntary nervous system.
   7. Running, talking, etc. are subject to the voluntary system.

G. The Digestive System
   1. The arrangement of specialized organs and processes to convert food as eaten into the proper combination of chemicals needed by the cells to maintain their structure is known as the digestive system.
   2. The organs participating in this function are mouth (teeth and saliva); esophagus (route to stomach); stomach (motion and juices); pancreas and liver (secretions); small and large intestines (structure and action); and bowel (evacuation of waste).
   3. Good nutrition involves supplying the digestive system with foods it can handle. Some foods are "hard to digest."
   4. A cheerful attitude assists digestion while fear, anger, and sorry retard good digestion.
   5. Appearance, smell and taste of food are usually but not always reliable measures of goodness.

ACTIVITIES -- Grade 5

II. Man

A. Skeletal System

   1. Have the children work with a cloth bag. They will realize that the bag has no form. Guide them into using sticks to give the bag form. Have the children relate this to the bones of the body.
   2. Examine worms to demonstrate how different animals can look and

move if they don't have a skeletal system.

3. Emphasize that each child is a living example of a skeletal system. Allow them to feel their own bones and discuss what they can discover by doing this.
4. Have them examine a drawing of the human skeleton.
5. Point out that teeth are a part of the skeletal system. Review care of the teeth.
6. Discuss with the child the reason for their head feeling hard.
7. Ask them if they can explain what a soft spot is on a very young baby.
8. (a) Have the children feel their ribs. Ask them why it is necessary for the ribs to be rather close together.
   (b) Explain that the ribs do not only protect the front of the body but also the back.
   (c) Point out that the heart and lungs are about equal distance from the front and rear ribs.
9. (a) Demonstrate how the ball and socket works. Have the children try out their own ball and socket join (arm and shoulder) to discover its abilities and limitations.
   (b) Make drawings of the ball and socket joint.
10. (a) Demonstrate how the hinge type joint works. Have the children try out their own hinge joints (elbow and knee) to become aware of its abilities and limitations.
    (b) Make models of the hinge type joint with sticks and rubber bands.
11. (a) Have the children slowly run their finger up their backbone or someone else's backbone to realize that there are a great number of small bones rather than one solid bone.
    (b) Have them count the bones of their spine.
    (c) Examine the back bone on the visible man and count the number of vertebrae.
12. (a) Stress the importance of good posture. Demonstrate that proper posture allows the bones and other organs to function properly.
    (b) Discuss how bones can be kept healthy by eating the proper foods; stress the basic diet needed.
    (c) X-rays or drawings of healthy and deformed bones should be made available to allow the children to make their own observations and conclusions.

B. Respiratory System

1. (a) Have the children demonstrate inhaling and exhaling. Ask them to describe their feelings while demonstrating both processes.
   (b) Demonstrate how artificial respiration helps this process work when it is temporarily interrupted.
2. Pupils can find the volume of air that the lungs can displace by exhaling into a water filled jug inverted and placed in a larger water filled vessel. A rubber tube runs from mouth to inverted jug.
3. (a) Aid the children to run experiments to identify some of the parts of air; oxygen and carbon dioxide.
   (b) Discuss oxygen and its use by the body. Have the children

check for oxygen by oxygen's ability to support combustion.
- (c) Discuss carbon dioxide and how it is produced by the body. Have the children check for carbon dioxide by exhaling into a jar with a lighted candle in it.

4. (a) Use a drawing or a model to demonstrate the route of air to and from the lungs.
   (b) Have the children list the organs involved.
5. (a) Have the children count their number of breaths for a specified amount of time. Have the children exercise for a few moments and then count their number of breaths for a specified amount of time. Let them compare the rates and explain the differences.
6. (a) Allow the children who have had respiratory ailments or obstructions to describe their experiences and feelings.
7. Make children aware of and show them current reports and surveys on air pollution.

C. Circulatory System

1. A working model of the circulatory system can be constructed to show to a degree how the system functions. On three separate pieces of wood construct a clay vessel about two inches deep. These will represent the lungs, the heart and the body. Place two short glass tubes through the lung vessel, four through the heart vessel and two through the body vessel. Use rubber or plastic tube for all connection of parts.
   Note that the tubes that carry liquid into the lung and body vessels are placed higher than those that carry liquid away. Fill the clay vessels with water to a depth of about one inch. To operate the model, place a little ink on one of the vessels so that the course of the blood can be seen easily. Slowly raise and lower the upper edge of the board on which the heart is placed.
2. Have a discussion to bring out the fact that their pulse is the same as their heart beat. Have the children record their pulse and heart beat while at rest and immediately after exercise.
3. (a) Discuss the fact that bleeding occurs when a blood vessel breaks or is cut. If the skin above the vessel isn't broken, a bruise will appear. When the skin is also cut and the blood escapes, we refer to it as a cut.
   (b) Pressure applied to a bleeding area will slow or stop bleeding. This can be demonstrated or tried by the children the next time a pupil is cut.
   (c) Clotting is the body's way to stop bleeding. Air helps clotting, but the blood itself must have a certain thing in it to clot.
   (d) Impress upon the children that if a lot of blood is lost through bleeding it is dangerous.
   (e) Blood transfusions can be successfully used to replace lost blood.

D. Glandular System

1. (a) Locate the position of glands by consulting various references.
   (b) Make drawings of the glands with emphasis on their location.

2. (a) Make the children aware of the latest reports and surveys available on the various glands.
   (b) Point out that the adrenal gland is one which is affected by emotions and fears.
   (c) Have the children compile their information into written reports.

E. Nervous System
1. (a) Point out that the brain is part of the nervous system. The brain and the spinal column are the central bodies of the system.
   (b) Have the children try to find out how many "nerves" they have. This pursuit will reveal that the nerves are minutely small, infinite in number and can be found everywhere in the body.
2. (a) Develop the fact that the nervous system is responsible for our sensations such as sight, hearing, smelling, feeling (touch) and testing.
3. Form groups to allow children to test for and time children's reactions.
4. (a) The nervous system can react involuntary, such as when we are breathing. Have the children discuss why it is vital for certain actions to be involuntary.

CONCEPTS -- Grade 5

III. Electricity

A. Electric current flowing around a piece of soft iron makes a temporary magnet.
B. Electromagnets usually remain magnetic only while electricity is flowing through them.
C. Electromagnets may be made stronger by increasing the number of turns of the wire or by doing both of these things.
D. Like other magnets, an electromagnet has a north pole and a south pole.
E. The poles of an electromagnet may be reversed by reversing the electric current.
F. Electric motors contain electromagnets.
G. A dry cell contains chemicals which, as they react one with another, release an electrical current.
H. Electricity is believed to be the movement of electrons.
I. When electrons pile up on each other, but stay still, we have static or frictional electricity.
J. When too many electrons become piled up, they move and we have current electricity.
K. A fuse is the weakest link in an electrical circuit.
L. A switch is used to break the path of an electric current.
M. When insulation wears away, two wires may touch each other and most of the current will flow through a shorter path, which is called a short circuit.
N. A.C. or alternating current, is the type of electric current that changes its direction rapidly.

O. D.C. or direct current is current which flows steadily in one direction. -
P. Electrical energy can be converted into other forms of energy - into heat, light, and motion.

ACTIVITIES -- Grade 5

III. Electricity

A. Electromagnet. You will need a length of insulated wire, a soft iron nail, a large darning or embroidery needle, a dry cell or lantern battery and a package of iron filings. Make the wire into a coil by wrapping it around the needle or nail. Test the soft iron nail to see whether it will pick up iron filings. If it has not already been magnetized, it should not pick up the filings. Now attach the wire coil to the two terminals of the battery. Put the soft iron nail inside the coil and test it with the iron filings. Does it pick them up? Disconnect the coil from the battery. What happens? Probably most of the filings will immediately drop off. A soft iron nail loses most of its magnetism as soon as it is no longer inside a coil carrying an electric current. If all the filings do not drop off, however, the explanation is that in these days nails made entirely of soft iron are not readily available. The manufacturers nearly always make nails with at least a little steel so that the nails will not bend so easily when you hammer them. It takes longer for the current to magnetize steel than soft iron. And it takes longer for steel to lose its magnetism when the current is cut off. Repeat experiment 1, using the steel darning needle in place of the soft iron nail. If the needle does not pick up any filings after the coil is disconnected from the battery, connect it up again and leave the needle in the coil a while longer. It takes a much longer time to magnetize steel than it does iron, but the steel holds the magnetism longer. The soft iron magnetized by electric current is called a temporary magnet while the steel magnet or one of the new alloys is called a permanent magnet although it will lose its magnetism in time.
B. Use a compass to determine the north and south pole of an electromagnet.
C. Using electricity to make a magnet. Wind about twenty turns of wire about a test tube. Connect this in series with a switch and dry cell. Place a nail in the tube, point end first. Close the switch for about 15 seconds. Open switch, remove nail and test to see if it is magnetized. Note poles. Follow the same procedure except that this time insert the head end of a nail first. Test nail for magnetic characteristics. Again note the poles. Next, reverse the connection of the coil at the dry cell. Repeat the above experiments. Note the polarity of magnetism of the nail.
D. Homemade Galvanometer. Wind several feet of insulated copper wire around a cardboard mailing tube. Leave a long length of wire at one end of the coil. Wind several turns of wire around a compass parallel to the needle. Remove the covering from the free ends of the wires. Connect the wire from the coil. Now push a bar

magnet through the coil. Does the needle move? Pull the magnet out of the coil. Does the needle move again? Notice which direction the needle moves as you push the magnet back and forth through the coil. You will find that the current flows in one direction when you push the magnet in and another direction when you pull the magnet out.

Hold the magnet still and move the coil. Are the results any different from those when you moved the magnet?

Try stopping the magnet at different parts of the coil. Observe what happens to the needle.

Some schools have commercial galvanometers in their science closets. Where this is the case, substitute the galvanometer for the compass.

E. Examine commercially built electric motors. Find the electromagnet.

F. Examine a bell or buzzer. Find the electromagnet. See how the device called the automatic circuit breaker operates. Trace the path of the current from binding post to binding post.

G. Collect several different pieces of electric cord from old appliances. Peel back the insulation on the cord so that it can be seen. The wire may have one layer or several layers of insulation. Discuss the dangers and hazards involved in cases of faulty insulation of wires.

H. Carefully breaking the glass of a discarded light bulb (wrap with cloth), examine the filament and construction of the bulb. Committee may do research on Edison and development of light bulbs.

I. Voltmeter. Measure electricity in dry cells to see the number of volts it produces. Try the same on weak, worn-out batteries.

J. Let the children experience setting up parallel and series circuits. Discuss parallel and series Christmas tree lights.

K. Allow better students to work out more difficult problems with circuits. Children might be interested in seeing how a light can be wired so that it can be turned on or off by either of two switches.

L. Children may examine and set up commercial type telegraph sender and receiver sets. Individuals can build their own homemade telegraph. Many variations for homemade telegraph sets can be found in almost any science book.

M. Fuses. Experiment to show fuses are the weakest link in a circuit. By constructing a simple board many experiments may be conducted. By inserting Christmas tinsel or aluminum foil in the alligator clips a complete circuit is in effect. However, when a short circuit is created the tinsel being the weakest link in the chain will melt and the circuit is broken. By using a heavy piece of foil for a fuse, students may see the wires heat up because the circuit cannot be broken. Children will observe that this may result in homes, if a penny or improper fuse (30-ampere fuse instead of 15-ampere fuse, etc.) is used. The children may wish to bring worn-out fuses of various types from home. In these fuses, they will be able to see how the soft fuse wire has melted, thereby opening the circuit so that electrical current could no longer pass through the fuse. This is especially easy to see in the fuses used in automobiles.

N. Make a survey in home and school as to the different kinds of switches found and how they work.

O. Make a list of things that use electricity to produce heat, light, and motion.

P. Producing electricity by chemical means. Any combination of two different metals with any salt or acid will produce a current of electricity. Some such currents are extremely weak and can only be detected by a sensitive galvanometer.
Place acid in a pint jar. Submerge a copper and zinc strip in the acid. Bell wire is connected from the two metal strips to the lamp. The zinc strip accumulates extra electrons. The copper strip loses the electrons making it "electron hungry." As a result a path of electricity is created between the two strips. Electrons flow from zinc to copper.
Variation of this wet cell.
Ammonium chloride solution rather than acid is used and a carbon rod rather than copper strip is used. This wet cell resembles a dry cell closely differing in that ammonium chloride is in a paste form in the dry cell.

Q. Have the school custodian show the class how storage batteries furnish emergency power for the school.

CONCEPTS -- Grade 5

III. Energy - Light

A. Man has learned many ways of making light.
B. Light travels in straight lines.
C. Light is bent or refracted when it passes from one medium to another.
D. Light that is bent continues to travel in straight lines after it is bent.
E. Light can be reflected from objects.
F. Some things shine because they are sources of light. Most things are seen because they reflect light.
G. Mirrors can bend and concentrate life.
H. We can get a reflection from a reflection.
I. A prism can be used to separate white light into the many colors of which light is made.
J. Color depends on the ability of an object to absorb certain colors and reflect other colors back to our eyes.
K. Color also depends on the kind of light that is illuminating the object we look at.
L. Light does not pass through all materials in the same way.
    1. When an object absorbs so much light that none can be seen to have passed through, it is said to be opaque.
    2. A translucent body allows some light to pass through but objects cannot be seen through it.
    3. A transparent object allows practically all light to pass through; objects can be seen through it.

ACTIVITIES -- Grade 5

III. Energy - Light

A. Make a collection of objects and pictures which were used for giving light in early homes and those used in the modern home. Compare the various light sources for efficiency and safety. List advantages of modern light sources and disadvantages of old-time light sources.

B. Light travels in straight lines.

1. Darken the classroom as much as possible. Turn on the filmstrip projector and throw the beam of light on a wall. Strike two dusty erasers in the beam of light. The dust particles are illuminated causing the beam of light to become visible as it passes through the air.

C. Construct a pinhole camera. The "camera" can be made from any box which can be made lightproof. A salt box or an oatmeal box would be most satisfactory although the box does not have to be cylindrical. Make a small hole with a pin at the bottom of the box. Remove the cover from the opposite end. Stretch a sheet of waxed paper across this end and secure it with a rubber band, cellulose tape, or similar method. When the camera is help up to a window in a darkened room, with the waxed-paper end in front of the observer's eyes and the pinhole toward the window, an inverted image is seen. Best results are obtained on a bright day. The camera can also be used with a candle in a darkened room.

D. Refraction:
Place a pencil in a glass of water, so that some of the pencil is above the surface. Observe where the pencil enters the water and appears to be bent. This is caused by the bending or refracting of the light rays as they reach the air from the water. Light travels faster in air than water and so is bent slightly when it passes from one medium to another.

E. Stand two mirrors at right angles to each other with their edges touching. These edges may be joined with strips of tape. Place a clock in front of the mirror with the midline of its face opposite the junction of the two mirrors. Observe the image and compare with the image seen with a single mirror.

F. Stand two mirrors on edge with the reflecting surface facing each other. Place a coin or a lighted candle between the mirrors. Look in one mirror and see how many images are formed. Look in the other mirror.

G. The blending of the three primary colors of light produces white light. This can be demonstrated with three flashlights. Cover the bulb end of one flashlight with red cellophane, one with green cellophane, and the third with blue cellophane. The cellophane can be held in place with rubber band. After the room has been darkened, each flashlight can be flashed upon a screen and the color of light noted. Two flashlights can be focused at the same spot on the screen and the blending of the light can be noted. It probably will surprise the children to see that red light and green light blend to form yellow light. Not so surprising will be the fact that blue light and red light blend to form magenta, or that blue and green lights blend to form blue-green light. The children probably will be surprised to see that the red, green, and blue lignts blend together to form white light.

H. Separating white light:

1. Darken the room and stand near a window and hold a prism in

the rays of the sun. Twist it around until a band of colors are seen on the wall or on the ceiling. Because of its shape, the prism separates the sunlight into different colors of which it is made.

2. The children may wish to take pieces of paper of various colors, such as red, blue, and yellow, and place them in the sunlight. They should note the original colors. Then they should experiment with them to see what colors the papers appear to be when placed in the various colors of light separated by a prism. They will see that the red paper looks the same when placed in the red light as it does when placed in the sunlight, but that it looks different when placed in other colored lights of the prism spectrum. The same thing could be done with other colors.

I. Dark colors absorb more heat (and light) than light colors.
   1. Put a piece of black felt and a piece of white felt (these should be the same size) on the snow where the sun will shine on them. In a couple of hours, lift up the pieces of felt. Why did the snow melt faster under the black felt than under the white?
   2. Paint half of the interior of a shiny tin can black with water color paint. Fasten two coins or bits of aluminum foil to opposite side of the can with a drip of wax. Light a candle placed in the center of the can. Which coin falls off first? The one on the black side. Because the dark side got warmer faster.
   3. Make two envelopes large enough so you can put a thermometer in each one from black construction paper, one from white. Seal the envelopes containing the thermometers tightly and place beside each other under a light or on the window ledge in the sunshine. Open the envelopes fifteen minutes later. Check the thermometers.

J. Collect a group of materials such as clear and frosted glass, paper bags, notebook paper, cardboard, and various kinds of cloth. Use a flashlight to determine whether these materials are transparent, opaque, or translucent.

CONCEPTS -- Grade 5

III. Energy - Sound

A. Sounds are caused by energy and motion called vibrations.
B. Vibrations are caused by a moving object.
C. The ear is a complicated organ which transforms sound vibrations into nerve impulses.
D. The force with which an object vibrates determines the loudness or softness of sound.
E. The speed or rate of vibration determines the pitch (highness or lowness).
F. Sounds can be magnified. (speaker or megaphone)
G. The sound of one's voice is caused by the size of the vocal cords.
H. Sounds may be absorbed or reflected.

I. Porous, soft materials are good sound absorbers.
J. Metal and wood are good conductors of sound.
K. Speed of sound depends on the conductor and the temperature.
L. Sound waves may be reflected to produce an echo.
M. Acoustical engineers are trained in problems of controlling sound.
N. All sounds produced and transmitted cannot be heard by the human ear.

ACTIVITIES -- Grade 5

III. Energy - Sound

A. Make sounds with many objects, such as thin ruler, nail file, a strip of brass, a rubber band, drum, water glasses, etc. Listen to pitch and loudness.
B. Study various sounds to determine what is moving in each case: trumpet (lips), saxaphone (reeds), violin (strings), voice (vocal cords)
C. Discuss the importance of modern acoustics.
D. Use a toy telephone, a tin-can telephone connected by a waxed string.
E. Make a one-stringed instrument to demonstrate sounds.
F. Play the piano. Hit high and low notes.
G. Sing or talk and hold your hand on your throat.
H. Visit a local radio station to see methods of sound control, reflection, absorption.
I. Study the make-up of the ear and how it is used as a sound detector.
J. Discuss why the flash of lightning and the sound of its thunder do not reach the observer at the same time.
K. Sound tuning forks and place on different objects. (wood, metal, paper, water).

CONCEPTS -- Grade 5

III. Nature of Matter

A. Matter is anything that has weight and occupies space.
B. An atom is the smallest division of an element keeping the same characteristics of that element.
C. A molecule is the smallest division of a compound keeping the same characteristics of that compound.
D. Molecules are in continuous motion.
E. There is a space between molecules.
F. A substance changes its state when its molecules are speeded up or slowed down.
G. A mixture can be separated mechanically. (filtering, heating, cooling)
H. Many changes are constantly taking place about us.
I. No new chemical substance is formed in a physical change.
J. New substances are formed in a chemical change.
K. All substances are chemicals.
L. Some substances can be further divided by ordinary chemical means into simpler substances. Such substances are called elements.

M. Some chemical substances are produced when two or more elements are combined. Such chemical substances are called compounds.
N. A solid has a definite size and a definite shape.
O. A liquid has a definite size but takes the shape of the container into which it is poured.
P. A gas has no definite size or shape of its own, but spreads out until it fills its container.
Q. Substances can change or be changed from one state to another.

ACTIVITIES -- Grade 5

III. Nature of Matter

A. Place a drop of water on a microscope slide. Get a bottle of India ink. The bottle of ink must be labeled "India Ink" or "Carbon Ink". Dip just the tip of the pen into the ink. Put the tip of the pen in the drop of water on the glass slide. The less ink you get in the water, the better. Place the glass slide, with the drop of water and ink, on the microscope and focus on the drop. You should see tiny black particles of ink jiggle back and forth now and then. The jiggling motion is caused by moving molecules of water that strike the tiny ink particles.
B. Place a glass of water where it will not be moved. Let it stand for an hour or so. Without moving the glass, gently put a drop of vegetable coloring in the water. Let the water stand. Observe how the motion of molecules slowly spreads the coloring through the water.
C. Stand at one end of the classroom while a classmate pours a little ammonia into a flat dish at the other end of the room. How much time passes before you can smell the ammonia? The molecules of ammonia mix with those of air.
D. You can see moth balls disappear in this experiment. Put one moth ball into a tightly closed small bottle. Put another moth ball into an open bottle. Look at the two bottles every week or so. Can you see the moth ball in the open bottle grow smaller and smaller: You may have to wait two or three months, but it will finally disappear.
E. Inflate a balloon with air and tie it very tightly. Look closely at the balloon. Can you see any holes: Hang it up and look at it every day for a few days. Watch the balloon shrink. It shrinks because air molecules are escaping from it. The air molecules are so tiny that they actually pass through the tiny spaces between the molecules of the rubber.
F. Put a spoonful of cleaning fluid into a jar. Get the kind marked "noninflammable." Inflate a balloon, tie it, and push it into the top of the jar. Leave it for a few hours. Remove the balloon and untie it. Smell the odor of cleaning fluid in the escaping air. You can smell it because the cleaning fluid turned to a gas. It flowed between the spaces in the rubber into the balloon.
G. Very carefully, place a needle on top of some water in a dish. The needle is made of steel that is much heavier than water, yet the needle does not sink. The molecules at the top of the water hold

tightly together enough to hold up the weight of the needle. These molecules form the surface of the water. This experiment shows that the molecules at the surface of water are held together with considerable force.

H. Have the children go on an "element hunt" to find and bring to class as many common elements as they can. Children may prepare reports telling where the elements came from and giving other information about them. Make a labeled display of all the correctly identified elements that were found.

I. Solids, liquids, and gases:
Ask the pupils to go on a treasure hunt and bring to school samples of different materials. Items may include things that differ greatly in appearance -- rubber, ping-pong, golf balls, feather, wire, thread, rocks, sandpaper, fruits, copper, milk, oil, alcohol, soft drink, vinegar, etc. Ask the children to tell what all these different things have in common. Group according to solids, liquids, and gases. (Gas can be exhibited with an "empty" tumbler and a blown up balloon.)

J. Limewater is a harmless solution which can be purchased at a drugstore. When exposed to carbon dioxide it turns from a clear liquid to a milky one. Carbon dioxide reacts with the limewater to produce a white solid (precipitate) called calcium carbonate (chalk). To demonstrate this, first make sure the youngsters understand that human beings exhale carbon dioxide. Then have the pupils blow through a straw into a small amount of clear limewater. They will see it turn milky.

K. Make carbon dioxide:
When an acid and baking soda are mixed together a chemical reaction takes place. Carbon dioxide is one of the products. Vinegar is a weak acid and therefore safe to use in the classroom. Use about a teaspoonful of baking soda and about a tablespoonful of vinegar.

L. Carbon dioxide is heavier than air. Light a candle. Mix about two teaspoonsful of baking soda and some vinegar in a jar or pitcher. Hold the jar a little above and to the side of the flame, and gently pour the invisible gas on the flame. If enough carbon dioxide to encompass the entire flame is produced, the flame will go out.

M. Carbon dioxide can put out fires. Lower a candle into a jar of air and observe that it continues to burn. Place about two teaspoonsful of baking soda in the bottom of the jar. Pour in a small quantity of vinegar. Again lower the candle into the jar and observe that the flame goes out. The carbon dioxide produced prevents oxygen from getting to the burning substance.

N. The compound - carbon dioxide:
Open a fresh bottle of ginger ale or other soft drink. Pour the soft drink into the glass tumbler. While the liquid is still bubbling, hold a lighted match in the glass above the bubbles. (The burning match is extinguished.) Soft drinks contain carbon dioxide. The carbon dioxide is forced into the liquid under pressure when it is manufactured. When the cap of the bottle is removed, the carbon dioxide escapes.

O. Mix some iron filings and sulfur together and place the mixture in a test tube. Heat the mixture until it glows. Allow to cool and examine it. (The iron filings and the sulfur can no longer be distinguished from each other.) Remove the contents of the tube by breaking it. Touch the substance with a magnet. The substance does not cling to the magnet. A new substance, iron sulfide, has been formed. Iron sulfide is a compound. A compound is composed of two or more elements combined chemically. The two elements have lost their individual characteristics and the compound has formed new characteristics of its own.

P. Put a bit of cooked egg yolk in a small dish. Place the tip of a shiny silver spoon in it. Leave it for an hour and examine it. The tip of the spoon will become tarnished and a thin layer of black material formed on the spoon. This compound of silver and sulfur is called silver sulfide.

Q. Make a collection of chemical compounds -- salt, sugar, baking soda, vinegar, water, etc.

CONCEPTS -- Grade 5

III. Energy - Heat

A. Man receives light and heat from the sun.

B. Heat can be produced through collision, compression, friction, electricity, and chemical action.

C. When an object is heated something is done to cause its molecules to move about more rapidly.

D. When an object is cooled, something is done to cause its molecules to move about more slowly.

E. Some materials conduct heat better than others.

F. Some materials keep heat out better than others.

G. When heated most objects expand, when cooled they contract.

H. Liquids absorb heat when they evaporate.

I. The process of burning requires fuel, oxygen, and a source of heat.
   1. It produces heat, water, and other materials.
   2. Improper burning may cause a deadly gas to form. The gas is called carbon monoxide.

J. Heat can be transferred in any one way or in combination of three ways; namely, by conduction, convection, and radiation.
   1. The movement of heat from molecule to molecule through a material is called conduction.
   2. The transfer of heat by currents in a liquid or a gas is called convection.
   3. Heat can travel from one body to another even though there are no molecules between the two bodies to carry the energy. This is called radiation.

K. Conduction, convection, and radiation are common methods of heat transfer used in home heating devices.

ACTIVITIES -- Grade 5

III. Energy - Heat

A. Heat due to collision:

Strike a piece of flint or hard stone a glancing blow with a piece of steel and sparks will fly. Little pieces of flint and steel are broken off by the blow and the collision heats the little particles blazing hot. (CAUTIONS. Protect eyes.)

B. Heat due to compression:
Pump up a basketball or volley ball. Feel the rubber hose before and after pumping and notice how warm it has become through the compression of the air.

C. Heat due to electricity:
Wind several inches of this wire across the positive and negative poles of a dry cell. For a better effect coil the wire around a thin nail. Compare to the tungsten filament in a light bulb. Examine appliances that have similar elements - toasters, electric pads, electric blankets, irons, etc.

D. Heat due to friction:
1. Rub your finger against the desk. Notice how hot it gets.
2. Discuss why the amount of air in automobile tires is carefully checked. Tires moving rapidly over roads produce heat from friction. This causes molecules in air to expand and the air pressure in the tires increases.

E. Heat causes solids to expand:
1. Connect a fine iron wire between two upright supports about three feet apart. Suspend a small object weighing three or four ounces from the middle of the iron wire. Heat the iron wire using an alcohol lamp. Notice the sag in the wire. Alow the wire to cool and observe the wire contract. Repeat the experiment using electricity to heat the wire. Connect four dry cells in series (if available, a low-voltage transformer can be used) to the extreme ends of the iron wire with pieces of copper wire. As soon as the electric current flows through the iron wire you will notice how the wire expands and contracts each time. (When using electricity to produce heat be sure iron wire is connected to wooden supports or insulated metal supports.)
2. Discuss:
The sag of telephone wires on a very hot day and a very cold day, the spaces between the ends of steel rails of railroad track, the spaces in the joints of a bridge or a large new building.
3. ball and ring apparatus.
Many schools are equipped with a ball and ring apparatus. First insert the ball into the ring. It will pass through easily. Next, heat the ball for a few minutes and then try to pass it through the ring. To make a ball and ring apparatus screw a large wood screw part way into the end of a piece of wood. Into another piece of wood, screw a screw eye that is large enough to pass over the head of the screw. Heat the head of the screw in the flame of the burner. Try to fit the screw through the screw eye.

F. Different materials expand unequally:
1. Many schools are equipped with bimetal bars. (Two different

metals made into a single strip. Metals are usually copper or brass with iron). Heat the bimetal bar over an alcohol lamp or hot plate and watch it curl up. It will straighten itself out as it cools and contracts.

2. Examine oven thermometers, thermostats and other objects which make use of the bimetal bars.
3. Discuss the application of materials expanding unequally in relation to glass jars and their metal screw tops. (Why Mother heats the metal cover of a jar with hot water to loosen it).

G. Heat causes liquids to expand:

1. Obtain a metal can of about one-gallon capacity (spirit duplicator cans are excellent). Insert a bent glass tube into a rubber stopper that fits securely in the opening of the can. Fill the can to the very top of the neck with cold water. Firmly press the rubber stopper in the opening of the can. The excess water will flow out through the tube. Set the can on a hot plate and provide a glass or beaker to catch the water as the temperature rises. Turn the hot plate off as soon as the water begins to boil. You will notice that you have more than a gallon of water. Allow the can and water to cool. To get the water back to starting temperature it will be necessary to allow cold water from a faucet to flow over the can for 30-50 minutes. Now pour the water from the glass into the can, and you will find that it is back to a volume of one gallon again.
2. A variation of the above experimentmay be carried out in the following manner. Fill a pyrex flask with water. Add food coloring to the water to make the experiment more interesting. Fit a rubber stopper with a glass tube about two feet long. When the stopper is pressed into the flask the colored water will rise a short distance into the glass tube. Set the pyrex flask on a hot plate or alcohol lamp and heat it. Remove heat source before the water starts boiling. As the water is heated, water will rise in the tube. When cooled the water level in the tube will drop back to its original position.

H. Heat causes gases to expand:

Fit a gallon can with a stopper and a bent glass tube. Attach a rubber tube to the glass tube. Put about 4 inches of water in an aquarium. Fill a quart jar with water and set its mouth down in the aquarium, being careful not to lose any of the water from the jar. This can be done by holding a piece of cardboard over the mouth of the jar while inverting and lowering it. Heat the can which is full of air and slip the end of the tube under the edge of the quart jar. A quart of air is quickly transferred from the can to the jar. Four quarts of air expanded to five quarts of air. Now let the rubber tube remain in the water as the can is cooled. The water flows in the tube and into the can taking the place of quart of air that was transferred into the jar. Measure the water in the can. It will be approximately one quart. (If there is an air leak around the stopper a full quart of water will not be transferred.) You may want to relate the rol of air pressure in this experiment.

Find out about different kinds of thermometers. Make a chart or exhibit explaining how each kind works and how it is used.

I. Some schools have conductometers - composed of copper, aluminum and brass rods. Use this apparatus to see which metals conduct heat better.

J. Drive three nails into a strip of a board so that the heads are just flush with the surface. Paste a piece of paper over the end covering the heads. Hold this part over the flame until the paper begins to char. Observe that the paper directly over the metal heads did not char as readily as the surrounding areas.

K. Heat a beaker of water to boiling. Place a pencil, a glass rod, and pieces of different kinds of metals in water. Feel the tops of the different materials.

L. Heat travels in liquids by convection:
Secure a large pyrex beaker and fill it with water. Put some grated blotting paper particles or sawdust in the water and give them time to settle to the bottom. Now place the beaker over an alcohol lamp and begin to heat it. Observe the paths taken by the particle of paper. The paper particles follow the convection current set up in the water.

M. Different kinds of surfaces affect radiation:
Find three tin cans of the same size. Paint one can white, the other black and leave the third one shiny. Fill the three cans with hot water of the same temperature. Set cardboard covers on the cans and put them in a cool area. Check the temperature at 5 minute intervals. Note the difference in cooling.

N. Some of the better students might consider ways of illustrating the heating of homes, or of rooms in homes, by the use of radiation or convection systems or by a combination of them. Some pupils might wish to construct a model of a solar-heated house, as well as some of the other types. They also should indicate places in these systems where conduction plays a part in the transference of heat.

O. Find in newspapers stories of death and illness caused by carbon monoxide gas. Develop a statement of practices to avoid carbon monoxide gas.

P. Discuss method of prevention of forest fires.

Q. Invite local firemen to come to school and demonstrate simple fire-fighting equipment, and to talk on safety.

CONCEPTS -- Grade 5

IV. Machines

A. Simple machines help to do work.

B. A lever is a bar used for lifting or moving; levers reduce forces needed to lift heavy objects.

C. A block and tackle is used to lift or pull heavy objects. (loading a boat, setting up a tent)

D. A screw is used for fastening one thing to another or for holding things together. (holds furniture together, helps keep us cool in fans, helps move planes and ships by propellers).

E. The fulcrum is the place where the lever arm rests.
   1. The position of the fulcrum affects the amount of force needed to lift an object and the distance it can be lifted.
   2. The nearer the fulcrum is to the weight the less force is needed to lift the weight.
   3. The nearer the fulcrum is to the force the higher the weight can be lifted.

ACTIVITIES -- Grade 5

IV. Machines

A. Use some of the simple machines such as a hammer to remove a nail, a shovel to dig dirt, or a bar to lift a rock.
B. 1. Use a seesaw to show how unequal weights are lifted.
   2. Write experience stories about using simple machines such as a wheelbarrow, knife, or spade.
C. Observe some simple machines by taking a field trip to see how construction work is done, the pulley on the flagpole works, or a millwheel turning.
D. 1. Make some simple machines such as a paddlewheel to run water over, a simple pulley with spools, or a bench by nailing boards together.
   2. Use a meat grinder at home to see the workings of the screw.
E. Make a schematic drawing of the fulcrum and its application. Develop the necessary vocabulary.

CONCEPTS -- Grade 5

V. Earth and Universe - Structure

A. The earth has a hard, rocky crust, about eighteen to twenty-five miles thick.
B. No one knows whether the inside of the earth is solid or liquid.
C. Deep down inside the earth it is very hot, and sometimes liquid rock called magma, makes its way up to the surface.
   1. When cooled, magma hardens into rock.
   2. When magma finds a break in the earth's crust, it pours out in a molten stream of lava.
D. All rocks formed from magma are called igneous rocks.
E. Rocks formed from layers of sediment are called sedimentary.
F. Rock that has been changed from one kind of rock to a different kind of rock is called metamorphic rock.
G. Scientists believe that coal was formed from huge trees and ferns which grew millions of years ago when many parts of the earth were hot, steamy swampland.
H. Scientists believe that oil was formed out of dead sea animals and plants by pressure of layers of sediment.

ACTIVITIES -- Grade 5

V. Earth and Universe - Structure

A. Use a half empty tube of tooth paste. The metal tube will be like the solid crust of the earth. The tooth paste will be like the magma that can flow under pressure. Your thumb supplies the pressure. With the cap screw on tight flatten the tube so that the tooth paste is spread evenly inside. Now squeeze the lower half of the tube. What happens? With a pin make a hole near the cap end of the tooth tube. Press the other end of the tube. What happens?

B. Find out about the history of the land formations in your community.
   1. Use resource people from available colleges or industry.
   2. Identify local rocks through association with your school's rock collection kit or encylcopedia color charts.

C. Investigate books and encylcopedias to learn how coal was formed.
   1. Identify - Peat
      Lignite
      Bituminous
      Anthracite

D. Investigate sources that deal with the Geological Calendar. Plan to build a geological calendar or timetable in your classroom.

E. Select a pupil to prepare a report on the Moho project and present it to the class.

F. Examine carefully (1) granite-igneous rock, (2) sandstone, a sedimentary rock, (3) slate, a metamorphic rock.
   1. Make a chart to show how common metamorphic rocks were derived.

Metamorphic Rock	Derived From
Anthracite Coal	Bituminous Coal
Gneiss	Granite or Shale
Marble	Limestone
Quartzite	Sandstone
Schist	Shale
Slate	Shale

G. Visit the Muhlenberg College Museum.

CONCEPTS -- Grade 5

V. Earth and Universe - Movements of Earth and Moon

A. The earth has three different motions.
   1. It rotates on its imaginary axis every 24 hours causing day and night.
   2. It wobbles as it spins.
   3. It revoles around the sun every 365¼ days.
      a. Rate is about 1100 miles per minute.
      b. Seasons are caused by the tilt of the earth's axis as it revolves around the sun.

B. The moon, our closest neighbor in space, is about 239,000 miles from the earth.
   1. Principal effect of moon on earth is to cause tides.

C. A magnetic compass is a useful navigation instrument because it always points toward the north magnetic pole. (Northern Hemisphere)

D. The equator is an imaginary line half way between the north and south

poles.
  1. Latitude is the distance in degrees north and south of the equator.
    a. A sextant is an instrument for finding latitude.
- E. Longitude is the distance east or west on the earth's surface from Greenwich, England.
- F. Three proofs that the earth is round are; the top masts of ships in the distance can be seen first, different star constellations are seen in different places, and the earth casts a circular shadow on the moon.
- G. Navigators have divided the surface of the earth into a number of circles parallel to the equator.
  1. These circles are called parallels of latitude.
- H. Longitude is the distance east or west on the earth's surface.
  1. Longitude lines circle the earth from pole to pole, crossing the latitude lines.
    a. Starting from Greenwich, England, they are numbered from 0 to 180, both east and west.
    b. To find the longitude, a navigator needs to know the time in Greenwich and in the place where he is.

ACTIVITIES -- Grade 5

V. Earth and Universe - Movements of Earth and Moon

- A. Use the Trippansee Planetarium to show the movement of the earth and moon.
- B. Keep a record of sunrise and sunset long enough to see if days are getting longer or shorter.
- C. Demonstrate phases of the moon. Hold a ball (moon) a little higher than your head (earth) in the line between you and the light (sun). Stand about 20 feet away from the light. When the ball is exactly between you and the light, you will not be able to see any part of the half on which the light is shining. You may compare this to the invisible "new moon." If you move a little way around the ball you can see a very small part of the bright side. This is like the thin crescent which we can see when the moon is "new." If you move about one-fourth around the ball, you can see a quarter of the moon facing you. When you move so that the ball is opposite the light, you can see the "full moon" or all of the lighted half. If you keep on moving you will again come to see only a quarter of the moon, then the crescent, and finally the "new moon."
- D. Pupils who have had experiences with tides might describe what happens at the shore line as tides come and go, and why the arrival and departure of ocean vessels are timed to the tides.
- E. Give exercises to the children in finding locations through latitude and longitude.
- F. Have committees give reports in methods of navigation.
- G. Perform experiments to prove that the earth is round.
  1. By use of a toy boat, globe and pencil make a little paper boat with a pencil mast. Stand close to a globe while another person sails the boat toward you from the opposite side. Does the boat

appear all at once, or from the top down? Now try the same experiment on a flat surface, such as a table. Keep your eyes just above the table as the boat sails toward you. Do you see only the top of the mast first, or do you see the entire boat all the time?

2. By pictures of the Big Dipper and Southern Cross, and glove make a picture of the Big Dipper on a card. On another card make a picture of the constellation called the Southern Cross. Lay the card with the Southern Cross on the table, hold the globe, and hold the Big Dipper above the globe. Let someone place a little doll on the globe, right where you live. If the doll could see, which constellation would it see? Now stand the little doll on Australia and try again. Which constellation is visible from there?
3. By use of a card, a pencil, a box, a wooden block, round place, ball, and lamp. One at a time, hold each object in the sunlight or in front of a light so that it casts a shadow. Turn each object and watch what happens to the shape of the shadow. Which one casts the same circular shadow no matter which way you turn it?

H. Experiments to prove there are ocean currents:

Method: Fill a large jar with cold water from the faucet. Put a teaspoonful of ink in the ink bottle. Then fill this bottle with hot water. With your finger over the open end, lower the bottle carefully to the bottom of the large jar, so that the bottle rests on its side. Watch the warm water rise in a steady stream. When warm and cold water meet, the warm water flows up. Try it another way. Fill the large jar with warm water. Then put a teaspoonful of ink in the little bottle. Fill the rest with cold water, ice water if possible. With your finger, cover the open end of the bottle. Then lower it, sideways, part way into the water in the jar. Take your finger away. Watch the stream of cold water falling down. When warm and cold water meet, the cold water flows down. Materials: large glass jar, ink bottle, hot water, ice water.

CONCEPTS -- Grade 5

V. Earth and Universe - Beyond the Earth

A. There are many theories as to how planets came into existence.
B. The solar system includes nine planets, planetoids, meteors, comets, and the moons that travel around some of the planets.
C. Space in the universe is so great it is measured in light years.
D. There are many star systems in the universe.
E. The sun is our nearest star.
    1. The sun provides heat and light for the earth.
F. Stars are spherical in shape even though they sometimes appear to have points.
G. Constellations are sky patterns of stars.
    1. We can see the Big Dipper all year and the other stars only in some seasons.
H. Space is the distance beyond the earth's atmosphere.
    1. Rockets are helping us learn about space.

ACTIVITIES -- Grade 5

V. Earth and Universe - Beyond the Earth

A. Plan a field trip to the Lehigh Valley Amateur Astronomical Society on East Rock Road in Allentown.
B. Organize committees to study and report on meteors and meteorites, asteroids, comets, stars, and galaxies.
C. Have children make independent observations of the stars on clear evenings.
D. Plan a trip to the Fels Planetarium in Philadelphia.
E. Help children get a feeling for light years by doing some measuring on the playground. A basketball pole or swing stand could be the sun. Then use a tape measure and let one inch represent a light year. Distance to some of the nearby stars can be measured off. Sirius would be about 9 inches from the sun, Castor about 44 inches, Betelgeuse about 350 inches and the North Star about 13,000 inches.
F. Discuss difference between stars producing light and planets reflecting light. Shine a light on a mirror or pie pan and note reflection on ceiling wall.
G. Put a "North Star" on the end of an umbrella, and place the Big and Little Dipper stars on the opened umbrella in the appropriate places. Put other stars toward the outside edge of the umbrella. Rotate slowly to show how stars seem to move around the North Star. Place a"horizon" in front of lower edge of umbrella so that some of the stars falls behind this horizon as the umbrella revolves.
H. Experiments with jet propulsion.
   1. Get a carbon dioxide capsule from a hobby shop. Fasten the capsule to a toy car. Tie it securely with string. Place the car on the floor. Now, puncture the capsule with a needle. In which direction does the gas escape? In which direction does the toy car move?
   2. Blow up a toy rubber balloon until it is fairly large. Then let it go. What happens as the air rushes out of opening of the balloon? In what way does this rushing air behave like exhaust gases from a jet engine.
   3. Make a small boat out of a piece of wood about a foot long. Near the back end of the boat, bore a hole that slants toward the rear. Then get a rubber balloon that is long, not round. With rubber cement fasten the neck of the balloon in the hole so that an inch of the neck projects from the hole and points away from the boat. Blow up the balloon. Put the boat in water. What makes the boat go?
   4. Let two children squat on roller skates, then push against each other. What happens? Let one child on skates roll a bowling ball across the floor. This is the principle of a rocket. The ball (gas) goes one way, the child (rocket) is pushed the other way (action and reaction).
   5. There are many toy rockets on the market today - many of them operating on air or water pressure. Check with the children in your class. Most likely one of them will be able to bring their rocket to school for experimentation.

CONCEPTS -- Grade 5

VI. Air, weather, and Climate

- A. Winds are named for the direction from which they come.
- B. Moisture in the air is called humidity.
  - 1. Temperature determines amount of moisture content.
  - 2. Evaporation places moisture in the air.
  - 3. Condensation removes moisture from the air.
- C. Different clouds bring different weather.
  - 1. Thunderhead
  - 2. Cirrus
  - 3. Stratus
  - 4. Nimbus
  - 5. Cumulus
- D. High pressure areas bring fair weather.

ACTIVITIES -- Grade 5

VI. Air, Weather, and Climate

- A. Set up a weather station in the classroom using rain gauge, wind vane, cloud direction indicator, barometer, and air movement indicator.
- B. 1. Construct a wet-and-dry bulb, and hair hygrometer.
  - 2. Have children bring in examples of hygrometers from home such as those that turn color, liquids that get cloudy, and ones in which statues move in and out of a house to indicate good and poor weather.
  - 3. Fan a wet chalk-board to illustrate wind in evaporation.
  - 4. Wet two identical pieces of cloth. Place one in a refrigerator (outside if cold enough) and the other in the room. Record time it takes for the cloth inside to dry and compare it to the still-wet cloth in the refrigerator.
  - 5. Show moisture forming on a glass of cold water.
- C. 1. Arrange a display of different clouds made of cotton for a bulletin board. Black tempera paint can be used effectively to make clouds more realistic.
  - 2. Make vocabulary list of specific clouds and associated weather.
- D. Measure air pressure with barometers made in the classroom:
  - 1. Stretch a piece of balloon over the top of a clean, dry milk bottle and secure tightly with a rubber band. Cut a soda straw in half and glue one end to the center of the balloon. On a 3 x 5 card held vertically, draw a line and mark it "normal." Draw lines 1/8" apart, above and below the normal line. On a wall, away from direct heat and cold, fasten the card so that the straw points to "normal." Children can observe pointer rising and falling with changes in air pressure outside the bottle.
  - 2. Use a large bottle, a rubber stopper with a hole in it, and a glass tube at least six inches longer than the bottle. Pour colored water into the bottle, to a depth of about an inch. Put the tube through the stopper and then into the bottle. The lower end of the tube should be about one-half inch below the

surface of the water. Press the stopper in firmly. Blow a bit of air into the tube, enough to send two or three bubbles into the water. The water should rise into the tube about half way. Then blow a few more bubbles, to bring the water still higher. Keep blowing until the water in the tube is about two inches above the stopper. On a white card make a line five inches long, marked off every quarter inch. Number the marks from 0 to 20. Cut two slits in the card and slip it over the tube. Now it is ready for work. Barometer should be kept in a part of the room where the temperature remains fairly even.

CONCEPTS -- Grade 5

VII. Conservation

A. Soil is the primary source of our food, clothing, and shelter. Our security depends on the wise use and proper treatment of soil.
B. Soil is renewable under certain conditions.
C. We can save soil.
D. Wind and water erosion are major factors in creating and destroying soil.
E. Soil, plants, and animals are interdependent.
F. There are many kinds of wildlife in Pennsylvania.
G. Wildlife contributes great social and aesthetic values to man.
H. In early days man hunted and fished for food and trapped for skins to keep his family warm. Today hunting, sport fishing, and much of the trapping are for sport and pleasure rather than of necessity.
I. Recognition of and a wholesome respect for laws in the wildlife conservation program are necessary.
J. Wildlife creatures belong to all the people.
K. Good farmer-sportsman relations are desirable.
L. Good farming and abundant wildlife go hand-in-hand.
M. Snakes are part of our wildlife and are both interesting and economically important.
N. Fishing is a fast-growing popular sport.

ACTIVITIES -- Grade 5

VII. Conservation

A. 1. Contact your county agricultural supervisor, county agricultural agent or the soil conservationist of the Soil Conservation Service. He can tell you of soil conservation measures in your area.
   2. Rub rocks together to form dust and small particles. Plant seeds in this dust and keep it watered. Add to the rock dust an equal amount of humus (good woods soil or good topsoil,) plant seeds, and care for them as in the first experiment. What makes the difference in plant growth? What do you conclude is necessary in soil?
   3. Plant seeds in different kinds of soil. Observe in which kind they grow best.
   4. Test soil for acidity by using litmus paper. Find out from a

farmer or florist what plants need an acid soil and what plants do not.

5. Measure water-holding capacities of various soils. One way to do this is two old-fashioned lamp chimneys or cylinders. Tie a cloth over the top, turn them upside down, and fill them about two-thirds full with two different soils. Be sure the soils are dry. Place the chimney in small-mouthed fruit jar. Pour a pint of water into each chimney. Then note how long it takes the water to begin to drip into the jars, how much water comes from each soil, and how long the water continues to drip.
6. Discuss how many acres in the nation and in Pennsylvania have been damaged by erosion.
7. Discuss the effect of soil erosion on our communities. How are the lives of the people affected where soil erosion causes the drying up of springs and wells?

B. 1. Collect leaf mold and humus from a forest to show humus. Examine carefully.
2. Collect soil from (a) a field in which no crops have been plowed for several years and (b) a field in which vegetation has been plowed under regularly. Note the difference. What caused the difference?
3. What difference is there between topsoil and subsoil? Plant some seeds such as radishes in each and note developments.

C. 1. Note the slope of land on different fields.
2. Talk about soil and water conservation practices which help to reduce run-off and soil loss. (Contour farming, grassed waterways, terraces.)

D. 1. Collect pictures or draw a mural showing good soil conservation practices, such as strip cropping, contour farming, tree planting, diversion terraces, and grassed waterways.
2. Discuss ways to keep soil from eroding.
3. Collect water from a small stream before and after a rain. Let both samples settle and make comparisons. What becomes of the soil carried in muddy water?
4. Use an electric fan or vacuum cleaner attachment to show how wind will blow unprotected soil. A tray with bare soil and another covered with sod will show how unprotected soil erodes by wind action and how a surface cover prevents the soil from blowing away.
5. Find out whether any land in your community has been abandoned for agricultural use. What use has it now, or to what use could it be put to conserve the soil?

E. 1. Have someone make a large poster of the conservation pledge.
2. Pour water into a jar of soil. Look for the bubbles that rise to the surface. Emphasize that plants cannot grow without air in the soil.
3. Discuss how plants and animals make soil fertile and enable it to take in water. Look up the work of earthworms in an encyclopedia or science book.
4. Find and bring to class a rock that has lichens growing on it.
5. Find a rock that has been "weathered" by the elements. If it

is possible, break the rock. Weathering of rock makes soil.

6. Note any broken sidewalks where tree roots have caused breakage. Trees and other plants help break rocks. The force of growing plants exert tremendous pressures, even enough to break rocks.
7. To illustrate what happens when a raindrop strikes bare earth, put some soil in a small baking tin. With a medicine dropper, drop water from 3 feet above the tin onto the soil. Have the pupils watch to see that the soil puffs upward when the water hits it. Make a mound of this soil, drop more water, and see if erosion takes place.

F. 1. Explore the community to determine the kinds of wildlife.
2. Make a scarpbook of birds, fish, and other animals. Have pupils report on these birds, animals, and fish.
3. Collect and mount pictures of wildlife found in your community.
4. Invite your local fish warden or game protector to talk to your class about his work. He also has movies available.
5. Make plaster casts of tracks of birds or animals. Find a good track--one that is clear and sharp in mud, dirt, sand, or hard-packed snow. Directions for making casts are found in most science books.
6. Visit a taxidermist or a museum to view mounted specimens.

G. 1. In terms of rest and recreation and escape from the mechanized world, the values afforded by hunting, fishing, photography, nature hikes and bird watching are significant.
2. Help class to enjoy books, pictures, bird recordings, and films showing the beauty of nature and animals.

H. 1. Discuss fishing and hunting done by families in your community. Good bulletin board displays can be made. Discuss furs, use of deer skins for gloves and jackets.
2. Have a student who is interested in trapping send to the Pennsylvania Game Commission, Harrisburg, for a copy of "Pennsylvania Trapping and Predator Control," by Paul Failor. (25¢)

I. Obtain copies of Fish and Game Laws of Pennsylvania. Discuss the reason for open and closed seasons, bag limits, and why certain areas are closed or open to hunting and fishing.

J. Discuss: Wildlife creatures are public property but this does not permit the right to hunt or fish on private land during "closed seasons" or without permission from the landowner during "open seasons."

K. Discuss the characteristics of a true sportsman in reference to hunting, fishing, and trapping.

L. A visit to a farm where good soil conservation practices have been applied will reveal good habitat for game species such as rabbits, pheasants, squirrels, and bob-white quail as well as for song and insectivorous birds.

M. Snakes are probably more feared and misunderstood than any of our native wildlife. Most snakes in Pennsylvania are beneficial. They feed mainly upon mice, rats, and other rodents, as well as insects. Pennsylvania has 3 poisonous snakes -- rattlesnake, copperhead, and massauga, all belonging to the pit viper family. Harmless snakes can be kept in the classroom in a properly built cage. Garter snakes, redbellied snakes, ring-necked snakes and milk snakes are excellent pets.

N. Discuss the availability of fishing to most areas--natural bodies of water, and man-made lakes and ponds make fishing available to everyone.

CONCEPTS -- Grade 6

I. Animals

A. Microscopic animals can be found almost anywhere about us. Some are helpful.
B. Animals, regardless of size, are composed of cells.
C. Animals have various adaptation for self protection.

ACTIVITIES -- Grade 6

I. Animals

A. Collect pond water and examine under the microscope. List helpful and harmful microscopic animals.
B. Examine microscopic slides of various animal specimens. Note similarities in cell structure.
C. In what ways have animals adapted themselves for protection? How?

CONCEPTS -- Grade 6

I. Plants

A. There are many differences in plants; nevertheless, they all have much in common.
B. The prime function of plants is to make possible the growth of new plants. (Reproduction)
C. Plants reproduce their kind in different ways.
    1. Algae reproduce by dividing.
    2. Yeasts reproduce by budding.
    3. Molds, mosses, and ferns reproduce by spores.
    4. Flowering plants reproduce by seeds.
    5. Plants may be propagated by cuttings, runners, and grafting.
D. By cultivating, propagating, and improving conditions of growth, man has improved many varieties of plants.
E. All plants need favorable conditions to grow.
    1. Germination requires warmth and moisture.
    2. Growth requires food and in most instances sunlight.
    3. Photosynthesis is the process green plants use to manufacture food in the presence of sunlight.
    4. Plants that cannot manufacture their own food must grow on food that is supplied by other sources.
    5. If any of the necessary elements are withheld from the plant the growth will be affected.
F. Every part of the plant has a specific function.
    1. Seeds are the source of new plants.
    2. Flowers contain the seed and fruit of the plant.
    3. Roots and stems are the systems that carry water and necessary minerals to all parts of the plant. They also anchor and support the plant.
    4. Leaves are the food factories of green plants.
G. Plants may be grouped or classified according to their similarities:

1. Plants that produce seeds and those that do not.
2. Plants that are green and those that are not green.
3. Plants that live one year are annuals.
4. Plants that live two years, bloom and then die are biennials.
5. Plants that live more than two years are called perennials.
6. Each kind of plant has certain distinguishing characteristics.

H. Nearly all plants change with the seasons and are equipped with adaptations for these changes.
I. Most plants grow toward the sunlight.
J. The roots of most plants are affected by gravity. (Roots grow toward the center of the earth).
K. Man depends on plant life for existence.
   1. Plants are a source of food, clothing and shelter.
   2. Plants replenish the oxygen supply in the air.
   3. Plants play an important role in the conservation of all life.
L. Conservation is man's responsibility to repair the harm he has done by upsetting the balance of nature.

ACTIVITIES -- Grade 6

I. Plants

A. Bacteria:
Sterilize four jars. With clean hands prepare slices of potatoes. Place a slice of potato in each jar. Seal one jar immediately. Move your finger over the potato of another, then seal it. Spread some ordinary room dust on another potato, then seal it. In the fourth jar, let a fly walk over the potato and seal. Place all jars together in a warm dark place for a few days. Observe. Count the colonies of growth which appear.

B. Yeast:
You will need a dish or glass, cake of yeast, small amount of water, two or three teaspoons of sugar. Place water in glass, add about a teaspoon of sugar, and crumble yeast into solution. Growing yeast gives off bubbles of carbon dioxide. These bubbles in dough make bread porous or light. The teacher may extend this activity by having the class mix and set bread dough and watch it rise.

C. How spores develop:
Collect a gilled mushroom. Break the cap from the stalk and place it, gills down on a piece of white paper. Cover the cap with a dish and leave it undisturbed for a day. The dish will keep the spores from blowing away. When you lift up the dish and cap, you may see a spore print left by thousands of spores that fell from between the gills. Some spores are white and will not show up on white paper. Place a second mushroom cap on a sheet of dark paper. The spore prints will then be visible.

D. Mold culture:
Crumple a small handful of newspaper. Sprinkle (do not soak) the newspaper with water until it is damp but not limp. Place the ball of damp paper into the bottom of a clean food jar. With the cover on this will provide a moisture chamber essential to the germination of mold spores. Take a 1" x 1" square of stale dry

bread and rub one side of it along a dusty surface of a table. Carefully insert the square of bread into the prepared jar with the dusty side up. With the cover of the jar replaced, put the culture in a dark, warm area for several days. A variety of colorful molds may be seen; however, the most common bread mold, RHIZOPUS NIGRICANS, a black mold with cottony mycelia, will tend to take over the culture. With tweezers snip off a sample of the common black mold. Place the sample on a clean slide into a drop of water. Observe with the microscope or microprojector.

E. Collect mosses:
Mosses can be found in damp shady places. Good hunting grounds would be in woods, forests, swamps and fresh water. Collect specimens with ample soil around root structure and transfer to a terrarium. Water well once each week. If mold begins to develop, soil is too wet. Powdered sulfur sprinkled in the soil will help prevent mold growth. Avoid direct sunlight as this is injurious to growth. On dark winter days, it may be a good idea to have a lighted bulb over the terrarium for a few hours.
Moss may be grown from spores, although this is somewhat difficult. Shake the ripe spore capsule over rich soil and peat moss mixture. Water well and cover with a glass. As the little plants develop transfer them to a terrarium.

F. Collect fungi:
Mushrooms are found in warm damp places. Dig them up carefully to avoid damage to rootlike structures. Transfer immediately to a terrarium. Sulphur mushrooms are found at the bases of trees. Tree brackets or shelf fungi grow on the base of dead trees. These are best removed and dried. Puffballs and earthstars are found on the ground and may be transferred to a terrarium. Many of these club fungi may be put in bottles with a 10 percent alcohol solution to preserve them.

G. Collect ferns:
A variety of ferns may be grown in the classroom (Boston fern, holly, maidenhair, pteris, and asparagus fern). Ferns grow in wooded areas or shady places near streams. Carefully dig up the rhizome or underground stem. Transfer the fern to a large pot or terrarium. The soil should be a mixture of peat moss, good soil, and sand. Ferns require medium light and should be watered from the bottom. Do not let the soil dry out.

H. Roots grow toward water (Hydrotropism):
Plant some seedling on one end of a flat or box. When they are about 2 inches high begin watering them on the side fartherst from the plants. Continue watering in this manner for a week to ten days. Then dig away the soil and see if the watering had any influence on the directions of the growth of roots.

I. Basal rosettes:
Examples of basal rosettes are dandelion, hollyhock, wintercress, sheep sorrel, wild carrot, pansy, broad leaved and narrow leaved plantains, heal-all, teasel, and white clover.

1. Study basal rosettes around the school. In all probability any school lawn will be rich in basal leaves or rosettes. The most common forms found would be dandelions, broad-leaved and narrow-leaved plantains. A few of these may be marked

by simple markers in the fall before the snow comes. Reports may then be made in the spring as to how many came through the winter successfully. If pegs bearing numbers are driven into the ground beside the rosettes, it may be determined whether the plants survived a few months, a few weeks, or a year or more.

2. Observe the development of basal leaves and rosettes. Select two or more dandelions of equal size and vigor. Try pulling off half the leaves of one plant and all the leaves of another. See if this does much to weaken the plants by spring or, if you wish, in a longer or shorter time. Then try cutting off the head of the plant just below the surface of the ground. Notice if the underground system grows a vigorous new rosette in a short time, or if it produces more than one such head, or if it is killed by the treatment it gets. Then try digging out the deeper roots to see if this does the job of elimination.

J. Nature hike:
Take the children to a nearby wooded area. Observe the plants growing in their natural habitat: ferns and mosses in shaded areas, lichen growing near the base of a tree or on rocks, algae floating on ponds and streams, mushrooms growing on dead material, bracket or shelf fungi on trees, grasses and wild flowers in open spaces, small saplings struggling for light and air in the dense wooded sections, and many other specimens of plant life in their natural settings.

K. Leaf collections:
Make a collection of fresh leaves. Spread the leaves flat between sheets of newspaper. Place heavy books on the top of the papers. Use new sheets of paper the next day to hasten the drying process. After the leaves are thoroughly flat and dried, fasten them with rubber cement or Scotch tape to heavy pieces of construction paper. Label each leaf with the name of the plant from which it came and the date it was added to the collection.

L. Botanical Keys:
Botanical keys state the most reliable of the characteristics by which plant kinds are classified. Arrange them in outline so that the botanizer can start at the beginning of a key and "run down" the name of his plants. Children in grades five and six can easily work with keys with a great deal of success.

CONCEPTS -- Grade 6

II. Man

A. The Skeletal System

1. Bones support the body structure and protect soft vital organs.
2. There is a variety in bone structure to permit a variety of movement.
3. Good nutrition and good posture influence the health of our bony structure.
4. Marrow is the soft interior of bones.

5. The manufacture of red blood cells is carried on in the bone marrow.
6. The bones of children are less likely to break than the bones of older people.
7. The principle minerals of bones are phosphorus and calcium.
8. A broken bone must be "set" and rested until healing repairs it.
9. Anthropologists can estimate the size, weight and health (of the body) from sections of skeletal remains.

B. The Respiratory System
   1. The purpose of breathing is to supply vital oxygen to the blood.
   2. Exhalation rids the body of carbon dioxide.
   3. The nose filters and warms air to the lungs.
   4. The tonsils are guardians against infection of lower respiratory track.
   5. Air pollution (caused by dust, exhaust fumes and smoking of cigarettes) endanger the body's oxygen supply.
   6. Lung diseases cause the air sacs of the lung to be filled with fluid. This reduces air space and reduces the oxygen supply to the blood.
   7. Air is only 20% oxygen. Pure oxygen is administered to people whose lung capacity has been reduced by injury, disease or drugs.

C. The Circulatory System
   1. The blood is pumped from the heart through to arteries and smaller vessels (called capillaries) and returned to the heart through the veins.
   2. Blood receives fresh oxygen supply in the lungs and available nutrition through the intestine walls.
   3. Pulse is the heart beat rate.
   4. The heart is four chambered. It has four openings.
      a. Admits dark (carbon dioxide laden) blood.
      b. Pumps dark blood to lungs for removal of carbon dioxide and reception of oxygen.
      c. Admits oxygen rich (bright red) blood.
      d. Pumps bright red blood to arteries and capillaries.
   5. The heart beats continually day and night and rests only between beats.
   6. Exercise speeds up the circulation. Panting is the body's way of getting more air to supply a greater need of oxygen for the faster moving blood.

D. The Glandular System
   1. Glands are specialized cell clusters that manufactures certain chemicals and eject them into the blood stream.
   2. Glands work together, rather than independently, to regulate growth, activity, salt proportion and differences in human beings.
   3. The function of glands is not yet fully understood by doctors.
   4. The pituitary gland determines whether a person will be a dwarf, a giant or an average height. It also has other functions.
   5. Doctors may administer adrenalin (a product of the adrenal glands) to a patient with heart trouble.
   6. The thyroid gland is within the neck. If it is too active, a person may be thin and nervous. If it is too inactive a person may be heavy and inactive.

E. The Muscular System
   1. Muscles are bundles of specialized fiber cells capable of relaxing and contracting. Muscles are fastened to bones by ligaments. Muscles are fastened to muscles by tendons.
   2. Protein and vitamin B^3 are essential to good muscle tone.
   3. We cannot increase the number of muscles but we can improve the strength and size by exercise.
   4. Muscles become flabby by disuse and poor diet or disease.
   5. Muscular sprains are treated with hot and/or cold compresses to increase circulation to the affected area.
   6. Good abdominal muscle tone protects the soft areas not covered by bone.

F. The Nervous System
   1. The spinal cord is the central nerve encased in the back bone. It proceeds from the base of the brain and branches out to all parts of the body.
   2. Nerves carry messages from all the senses to the brain and return message responses to all parts of the body.
   3. The nerve for sight is known as the optic nerve; for hearing, the auditory nerve; for smelling, the olifactory nerve.
   4. While eyes and ears are the organs of sight and hearing; actual seeing and hearing are done by the brain and nervous system.
   5. A well balanced diet, plenty of sleep and happy thoughts are needed for healthy nerves.

G. The Digestive System
   1. Digestion is a process of changing the food we eat into chemicals needed by body cells.
   2. The organs involved are the mouth (crushing and grinding plus saliva); the esophagus (tube to stomach); stomach (motion and juices); liver (secretions); pancreas (secretions); the small and large intestines (structure and action) and the bowel (waste evacuation).
   3. Usable nutrition for the cells passes through intestinal walls (by osmosis) to enter the blood and be carried to all cells.
   4. Scientists have established the minimum requirements of various foods necessary to good health. Our diet should include fats, carbohydrates, sugar, proteins and minerals. If these foods do not contain adequate vitamin supply, we may supplement our routine with vitamin capsules.
   5. Regularity and cheerfulness assist our digestion.

ACTIVITIES -- Grade 6

II. Man

A. The Skeletal System
   1. Examine closely a skeleton to identify the following bones -

Skull	22 bones
Hyoid bone (front of neck)	1
Spinal column	26
Ribs	24
Breastbone	1

Arms and hands	64
Legs and feet	62
	200 plus 3 tiny bones in each ear

2. Have children read and discuss and if possible examine a model.
    (a) Why it is better that ribs are small separate bones instead of one large bone?
    (b) Why is the backbone made of many small bones?
    (c) Why does the body have joints?
    (d) What gives your foot strength?
3. Read in books how bones develop from cartilage before birth and how this ossifies and continues to do so until about 25 years of age. Page 82 in All About the Human Body, by Bernard Glemser, Random House, N. Y. 1958.
4. Examine real bones to observe marrow and blood cells. Read in all available source materials to learn what foods are needed to keep red blood cells manufactured.
5. Use animal cartilage and animal bones to experiment with differences in flexibility.
6. Have individuals make reports on such topics as (1) scurvy (2) beriberi (3) rickets.
7. Let class members tell of their experiences with broken bones. Invite a doctor in to explain how bones are set. Explain - simple fracture; compound fracture.

B. The Respiratory System

1. Draw pictures of the respiratory organs. (nose, mouth, trachea, bronchial tubes, lungs, air cells). Breathe deeply to feel air as it goes from nose to lungs. Read to find out the composition of air including oxygen.
2. Perform experiments to show how oxidizing produces carbon dioxide. Page 112-112 - ABC Science Series, Grade 6; many pages in Thurber's book called - Exploring Science - Grade 6; and Heath - Science for Today and Tomorrow.
3. Have children explain how the chest feels cold and achy when they breathe through the mouth on a cold day. Why?
4. Use available health texts, encyclopedias, etc. to find drawings on which children can locate adenoids and tonsils. Let children tell of experiences when they have had tonsils removed. Tell why they are removed.
5. Collect articles from newspapers about smog, air pollution tests, suffocation accidents, etc. Talk about the reasons for these being hazardous.
6. Perform the experiment below to show that when a doctor taps and thumps people, he can locate lung disease by sound.
    " You will need two empty milk cartons. Half fill one with sand and another with water. Tap the first one (containing sand) near the bottom, then a bit higher up and still higher, until you reach the top. Do you hear the same sound all the way, or does it change at one place? Does an air space give the same sound as a space filled with sand?
    Now try the same tapping experiment with the carton half filled

with water. Again you will hear a change in sound as you move up from the water-filled part of the carton to the air-filled part. In fact, you can even find the water level with your eyes shut."

C. The Circulatory System

1. All good health books have detailed pictures of the heart chambers, veins, arteries, capillaries, etc. Use these to trace the way one way the heart works and to show relationship of heart and lungs. Have several children look in encyclopedias to relate William Harvey's contribution to the work of the Circulatory System.
2. Have children take each other's pulse.
3. Discuss what happens when the heart fails to beat for a fraction of a minute.
4. Heath's Book - Science for Today and Tomorrow p. 156-158 gives the experiments listed below to show how exercise speeds up circulation -

"Measuring Your Breath"

Have you noticed that you breathe more deeply during heavy exercise? When you exercise, your body needs more oxygen, and your breathing muscles receive a signal to supply it by breathing more rapidly and by taking in more air with each breath. Here is a way of measuring the amount of air in a breath before and after exercise.

Experiment

You will need a gallon jug, made of glass, and a rubber tube. Fill the jug with water. Cover the mouth of the jug with your hand. Then place it, upside down, in a large basin half full of water. Slip one end of a rubber tube into the neck of the bottle. Place the bottle on two wooden blocks. Then, while you sit quietly, exhale one breath through the rubber tube. How far down does the water level in the jug go? Make a mark at this level. The space above the mark contains the air that you exhale in one "Quiet" breath.

Now do some heavy exercise, such as deep knee bending, for several minutes. While you exercise, have a classmate refill the jug and place it in the basin as before. Then, while you are still puffing and panting, exhale one breath through the tube. How far does the water level go down this time? Make a mark at the level and compare it with the first mark. How does exercise affect your breathing?

While you have the experiment set up, you may like to find out about how much air your lung's contain.

Experiment

Fill the jug again, then take a deep breath and blow as much as you can out through the tube. Make a mark at the water level. Do your lungs contain a gallon of air?

If other people wish to try the experiment, be sure first to sterilize the end of the rubber tube. A dip into boiling water will do it, or you can wet the end of the tube with alcohol and let it dry. Why is it necessary to sterilize the tube?

In your experiment you found that when you work harder, you breathe faster and more deeply. Breathing faster and more deeply supplies your body with the extra oxygen it needs when it works hard. More food is used when you work hard, too. More waste material is formed when you are more active. More materials are being carried by your body's transportation system, the blood. The extra amounts of materials can be carried because the blood flows faster when you exercise. How is the speed of the blood increased? This little experiment will show you.

Experiment

Sit quietly for two minutes and then take your pulse. What is your pulse rate when your body is at rest? Now do some heavy exercise such as knee bending, jumping, or toe touching for a full minute; then take your pulse. How fast is your heart beating when you exercise? Do you feel the difference in the force of the pulse?

D. The Glandular System

1. If possible have at least one copy of the book, "All About the Human Body," by Bernard Glemser, Random House, N.Y. 1958 added to your science shelf. This book has an excellent picture of the location of the following glands:

   Pineal
   Pituitary
   Thyroid
   Thymus
   Adrenals
   Pancreas
   Gonads

   The material preceding and following the picture explains the work of each gland.
   If the above book is not available use the list of glands as topics for committees to use to prepare reports from other source materials.

E. The Muscular System

1. Feel the muscles in your forearm to see how they get thicker when you make a fist and thinner when arm is extended. Feel the tendon at the inside of elbow.
2. Examine cereal boxes for protein and B complex vitamins.
3. Keep record of some physical exercise skill for a semester to check muscle building.
4. Discussion in which children tell of experiences with feeling of weakness after illness.
5. Refer to experiences of sprained fingers, toes, etc. from playground accidents. Tell how accident was treated.
6. Do sit-ups. Put hand on abdominal muscles. Talk of the function of these exercises.

F. The Nervous System

1. Secure Nystrom Anatomical Chart or New Compton's pictured encyclopedia anatomy.
2. Using several stimuli such as sound, light, warmth have children with stop watch clock each other time taken by nervous system to give response.

3. Show Walt Disney Films - You and Your Eyes, You and Your Ears.
4. Tell of incidents where brain injury kept people from seeing or hearing even though the eye itself isn't injured.
5. Discussion of how you feel after a late party, a period of disagreement with parents or best friends, or after over-eating party foods such as pizza and cokes.

G. The Digestive System
1. Grind various foods and place in a glass or porcelain dish. Add few drops diluted hydrochloric acid. Note change in smell, color, indicating chemical change. Recall odor from vomiting.
2. See any diagrams available in your texts that show the digestive organs. Discuss the written material in conjunction with the pictures.
3. Experiment showing osmosis -
   - (a) Put ½ inch strong vinegar in a saucer.
   - (b) Hold large end of egg in vinegar until shell dissolves and membrane is exposed.
   - (c) Make a small hole in the small end of the egg. Insert a glass tube. Work carefully.
   - (d) Seal opening around the tube with melted wax to make it water tight.
   - (e) Place the egg in a glass of colored water and let it stand a few hours.
   - (f) Liquid will rise in the tube. This liquid was pushed up into the tube by water that entered the egg through the membrane by the process of osmosis.
4. Make a chart with 3 meals - breakfast, lunch, dinner. Do research to find minimum daily food requirements. See if meals measure up to it.
5. Let children tell what time they eat evening meal. Ask if anyone can recall a time when the meal was extra late. Did the late hour affect the way you felt?

CONCEPTS -- Grade 6

III. Electricity

A. Man uses electricity as a source of energy for doing work, providing himself with light, increasing his comfort, and communicating.
B. Electricity is a form of energy.
C. A current flows only when the electrons can make a complete circuit.
D. Switches are a convenient way of breaking a circuit to stop the flow of electrons.
E. A generator is a device for converting heat or some other form of energy into electrical energy.
F. Large power plants use the energy in coal, falling water or nuclear fission to generate electricity.
G. Voltage (volts) is the pressure that forces an electric current through a wire.
H. The rate of flow of electricity is measured in amperes.
I. A watt is a measure of electric power. It is the rate at which electricity is used.
J. When electricity arrives at home it is measured by a watt-hour meter

and goes to all parts of the house.

K. Charges for the use of electricity are based on a unit called a kilowatt hour.

L. Transformers reduce or increase the voltage of current electricity.

M. A telegraph is a way of sending code messages, usually by means of electricity.

N. When a person speaks into a telephone transmitter, the voice vibrations cause an electric current flow in little spurts, one spurt for each vibration.

O. In the receiver of a telephone, the spurts of electricity flow through an electromagnet with a metal disc next to it. The electromagnet causes the disc to vibrate and produce sound vibrations.

ACTIVITIES -- Grade 6

III. Electricity

A. Review circuits, switches, fuses discussed in Grade 5.

B. Discuss how electricity gets from the power plant to the homes and factories where electricity is used.

C. Make a model of the outside appearance of a hydroelectric power plant.

D. Construct a simple transformer. (Directions found in Bond, a., Bond, T., Clymer, t., and Bell, K. Looking Ahead with Science Lyons and Carnahan, 1960, P. 180).

E. Take a field trip to observe power lines, insulators, ground wires running down some of the power poles to the ground, and small transformers on the power lines. It should be noted that the high-tension wires have much heavier insulators between them and the poleyards than do the low-tension wires. It may be noticed that the high-tension wires are not so thick as are those which carry lower voltage, the lower voltage carry more amerage.

F. To explain voltage and amerage compare electric current in a wire to water flowing through a pipe.

G. Children may list the voltage and amperage of electrical lights and appliances found in the home. Also determine if outlets are overloaded.

H. Construct a model of an electric meter showing the dials. Visit the school meters, keep a weekly record, compute the school's electric bill for one month. Each pupil do the same activity for their home meter. Compare the results with the bills.

I. Have a committee of interested children construct a telegraph set. Examine the commercial telegraph set from the school science closet.

J. Discuss the telephone and electricity showing how sound is transmitted. Set up a telephone and allow children to operate it. Draw charts and posters showing how a telephone works. If possible, visit the local telephone company and observe its operations.

K. Copperplating. Placing a heaping tablespoonful of copper sulfate in a water glass of hot water. Stir until the copper sulfate is dissolved. (Note: Copper sulfate is poisonous. Do not get any in mouth and avoid getting on hands.) Place a strip of copper in the solution. This forms a positive pole and should be connected by a copper wire to the positive pole of a dry cell. Place a carbon rod in the solution and connect it to the negative pole of a dry cell. Place a carbon rod in the solution and connect it to the negative pole of another dry cell. Now connect the two dry cells in series. Allow the current to flow for about three minutes. You will find a coating of copper on the carbon. The copper ions carry a positive charge and are attracted to the negatively charged carbon rod. Here they pick up electrons, become neutral and deposit themselves on the rod. The copper steadily releases positively charged copper ions into the solution and is slowly used up.

CONCEPTS -- Grade 6

III. Energy - Light

A. Our biggest source of light energy is the sun.
B. The electrons of the heated atoms in the sun give off light energy.
C. Light energy from the sun comes to us through space, but outer space is black.
D. Light unlike sound, can travel through space where there is no air.
E. Light energy travels in straight lines.
F. Light travels about 186,000 miles in one second.
G. Light as energy can be measured. The unit of measurement is the foot-candle.
H. Light energy can cause chemical changes:
  1. Photosynthesis
  2. changes camera film
  3. sunburns skin
  4. fades cloth
I. Light rays may be reflected or absorbed.
J. Colored materials reflect almost all the light which strikes them. The rest of the light is absorbed and turned into heat.
K. Light is bent or refracted when it passes from a medium of one density to another.
L. Lens can bend light to magnify objects or to focus images.
M. The mechanical operations of the eye and the camera are similar.
N. Proper lighting is important in the home, school, and work to perfor seeing tasks.

ACTIVITIES -- Grade 6

III. Energy - Heat

A. Heat is essential in order to produce light:
  1. We can seldom have light without heating. A few exceptions of light without heat are certain marine organisms and fireflies. A committee may be organized to investigate this subject further and report to the class.
  2. Strike a match, and you have light. Put the match to a candle, a piece of paper or a stick of wood, and again you have light. In every case, the light produced is yellow a yellow-white.

This is because the light is produced by glowing of particles of carbon. The oxidation of the fuel (the combining of the carbon and hydrogen in the paper and wood with oxygen in the air) is not complete. The carbon particles do not oxidize completely; they are caught up in the process and are made to glow by the energy that is produced.

B. Speed of Light:

1. Darken the room as much as possible. Stand in front of the room and point the flashlight toward the farthest wall. Snap on the light and notice how quickly the light seems to reach the wall. Flash the light on and off several times. Listen to the clock of the button on the light and consider this the instant that the light leaves the lamp. Notice that the spot of light appears on the wall at the same instant.
   Explanation: This experiment shows, in some measure, at least, that light travels at a tremendous speed. For short distances it is practically instantaneous. Light actually travels about 186,000 miles per second.

C. Regular and diffuse reflection:

To show the difference between regular and diffuse reflection you will need a source of light, a flat mirror, and a sheet of white paper. Darken the room. Hold the mirror so that the light strikes it and is reflected upon a wall. Notice the bright spot on the wall. Now shine the flashlight on the white paper instead of the mirror. Observe the difference between the two reflections.

D. Refraction:

Place a pencil in a glass of partly filled water and notice that it appears to be bent. Notice, too, that the lower part seems to be magnified. Put a penny in a small pan on a table. Sit at the table and push the pan away from you until only the outer edge of the penny is visible. Have someone pour water into the pan, being careful not to move the penny. Notice that though the penny was not moved, it can now be seen. This is because the rays of light which the penny sends out are bent when they pass from the water into the air. Some of these rays reach your eye and you are able to see the penny though without the water in the pan it was invisible. Notice, too, that the penny appears to be higher than it was, and seems to be in the direction from which the ray of light entered your eye.

E. Understanding sunlight: (or any other white light)

1. Secure a small mirror that will fit, at a slant, in a water glass or other glass container. Place the mirror in the glass so that it is at a slant and fill the glass with water. Place the glass on a window ledge or a table near the window so that direct sunlight hits the mirror. Slowly turn the glass around until you find a particular position at which sunlight is reflected onto a wall of the room. Place a white paper at this place. A rainbow of swimming colors will appear. Agitate the surface of the water and the color disappears and in their place appears a shimmering white light.

F. Mirages:

Fill a small glass half full of water. Place a coin in the glass and hold it at eye level. Now slowly raise the glass, at a certain point the coin appears to be in the air instead of in the water. When light from the coin reaches the top surface of the water part of the light is reflected toward your eyes. This makes the coin appear in the air instead of the water. A similar effect causes the mirages people often see in a desert or on roadways.

G. Optical Illusions:
Have a committee collect a series of optical illusions to show to the class.

H. The Eye:
Encourage the children to look carefully at their own eyes in a mirror or at the eyes of a classmate to see the tiny opening (pupil) and the eyelids and eyelashes that protect the eyes. They may feel their eyes through their lids to understand the roundness. They may take turns going into a dark closet and letting their classmates see the before and after effects on the size of the pupil. They may blindfold each other to see how many things they miss by not having the use of their eyes.

I. The Camera
The children may wish to bring their cameras to school and take some pictures. If this is done, the various parts of the cameras can be identified. If the teacher has a camera, it will be well to bring it to school and open it up so that the children can see how the shutter and the diaphram work. This is easily done by removing the back of the camera and pointing the front of the camera toward the window and then snapping the shutter. The shutter can be held open by using the time-exposure setting of the camera. Then the diaphram can be opened and closed to show that it allows various amounts of light to pass into the camera. The group may also be interested in examining and using the view finder of any of the cameras brought to class.

J. Discuss the importance of proper lighting in the home, school, and work. The booklets, "The Story of Light and Sight" are excellent in this study. (Available from the Better Light Better Sight Bureau or local power company.

K. Make an exhibit showing means of lighting homes, schools, factories, automobiles.

CONCEPTS -- Grade 6

III. Energy - Sound

A. Sound is caused by vibrating objects.
B. Sound waves may be absorbed, reflected or transmitted by substances.
C. In wind instruments sound is produced by the vibration of a column of air.
D. Sympathetic vibrations or resonance occurs when an object vibrates in tune with something else that is vibrating.
E. Sound is affected by length, weight, and tension of the vibrating object.

F. Quality depends on the "shape" imposed on the sound waves by the overtones.
G. Supersonic or ultrasonic sounds are the sounds that are too high pitched for human ears to detect.
H. Stereophonic sound results when two sets of sound waves simultaneously reproduced, one set for each ear.
I. Sound travels through material which can transmit the energy.
J. We respond to vibrations and sensations by organs of hearing and the nervous system.
K. Distance can be measured by sound using modern sound devices (sonar, seismograph).
L. Sounds may be transmitted through a wire, or through air.
M. Sounds cannot be carried through a vacuum.

ACTIVITIES -- Grade 6

III. Energy - Sound

A. Make sounds with a number of objects, such as thin ruler, nail file, a strip of brass, a rubber band, drum, water glasses, etc.
B. Make a one-stringed instrument. Lengthen and shorten the string to hear sound produced.
C. Make a list or chart of ways sounds help us.
D. Make various sounds and have children guess what was used to produce the sound.
E. Discuss supersonic or ultrasonic sounds. Read about bats and other animals who hear supersonic sound.
F. Discuss sound in motion pictures, phonographs or record players, telegraphs, telephones, radios, and television.
G. Build a crystal radio set.
H. Make a xylophone by using blocks of wood varying in length. Lay the blocks across a rolled newspaper.
I. Make a pop-bottle xylophone. Set a series of pop bottles on a table and fill each with water to make a musical note. Blow over the open end to produce a sound. Then, lightly hit each bottle with a wooden object to hear what sound is made. Why is there a difference?
J. Collect bells of various sizes, discover why the sound of a particular bell.
K. Discover how the vocal cords make sound.
L. Listen to voices and sounds with and without a megaphone.
M. Study a diagram or model of the ear.
N. Use tuning forks to feel vibrations.

CONCEPTS -- Grade 6

III. Energy - Heat

A. All motion produces some heat.
B. Kinetic energy is the kind of energy possessed by moving objects.
C. Heat is kinetic energy of molecules.
D. The higher the temperature, the faster the molecules move.
E. Heat flows from a hotter body to a colder one.

F. The temperature of a substance indicates how much kinetic energy the molecules of the substance have.
G. As the temperature of a substance is lowered, the molecules move more slowly.
H. Absolute zero is the coldest possible temperature (-459.6 degrees F). At this temperature the molecules no longer have kinetic energy.
I. Heat indicates how much energy a substance has.
J. Heat is measured in amounts, and the unit generally used is called a calorie.
K. Temperature tells us how hot or how cold a substance is and is measured in degrees.
L. Fahrenheit and Centigrade scales are the two scales most generally used to measure temperature with liquid thermometers.
M. When a temperature called the "melting point" is reached, the molecules "break the bonds" that hold them in a solid state.
N. Many of the changes that occur on earth are caused by heat or the lack of it.
O. When heated most objects expand; when cooled they contract.
P. All materials do not expand or contract in thesame way.
Q. Heat can be changed to motion.
R. Steam, gasoline, and Diesel-oil engines are all heat engines. They are designed to change into mechanical energy the heat energy that is obtained when fuel is burned.
S. In the steam engine, steam is made in a separate compartment called a fire-tube boiler, which has a steam pipe to the engine.
T. An internal-combustion engine operates a burning fuel inside the engine. Gasoline, oil, and kerosene are used as fuels.
U. Rocket and jet engines are the newest heat engines.

ACTIVITIES -- Grade 6

III. Energy - Heat

A. Discuss kinetic energy and give examples - running water, a moving car, a speeding rocket, a moving ball, etc.
B. 1. Hold a nail with a pair of pliers in a flame. As the nail is heated, the molecules move faster and faster.
   2. Drop a few grains of powdered ink into a beaker of cold water. Notice how slowly the grains dissolve and spread throughout the beaker of water. Now heat the water. As the temperature of the water is increased, the particles move faster.
C. Put equal amounts of cold water in two beakers. With the thermometer measure the temperature in both glasses. The temperature in each glass should be the same. Pour 2 oz. of boiling water into one of the beakers and 4 oz. into the other. Now measure the temperature of the water in each of the glasses. Observe if there is any difference between the two readings. The temperature of the water added in each case was the same. In one glass a greater quantity of heat was added. This experiment shows that heat and temperature are quite different.
D. Make a study of the different types of thermometers and how they work.

E. "Boiling water by cooling it." Secure a pyrex flask with a solid rubber stopper. Fill the flask half full of warm water. Heat the flask until it boils and cap it with the rubber stopper. Put it in a basin and pour cold water over it. The water will start boiling again. Invert the flask and place an ice cube on the top. Cooling condenses the water vapor above the water and reduces the pressure on the water. When the pressure is reduced, water boils at a lower temperature. This is why it takes so long to cook things at high altitudes.

A variation of this experiment is to use a one-hole rubber stopper with the flask. Insert a short glass tube through the stopper and attach to one end of a rubber tube. Fit the other end of the rubber tube to a vacuum pump. Start pumping to reduce the water pressure within the flask. Soon the water will begin to boil.

F. Boil water in paper. Secure a paper cup or make a box out of wrapping paper. Fill the cup or box about half full of water and place it on an alcohol lamp (avoid using electric hotplate in case water spills into heating elements). You can boil the water without burning paper. The paper conducts heat from the flame to the water and does not take fire because its kindling temperature is lower than the water.

G. Examine a bimetal (compound) bar if one is available. Notice that there are two different metals bound together in one place. Usually one of the metals is iron; the other brass. Heat the bar over a flame or hot plate. Notice how the bar bends. Bending occurs because the brass expands more than the iron.

H. Cold water is heavier than hot water, volume for volume. Pour two tablespoons of ink or food coloring into a transparent glass soda bottle. Fill the bottle with hot water. Wait until the air bubbles start rising and add more hot water. Fill a similar bottle with cold water. Cover the cold water bottle with a 2" x 2" piece of wrapping paper and press the paper down hard with your thumb to squeeze out a little of the water. Invert the cold water bottle and place its paper covered mouth over the mouth of the hot water bottle. Slide the paper out carefully and the colored water will rise into the upper bottle.

I. Hot air is lighter than cold air, volume for volume. Balance a stick on a cord attached to a support and balance two similar paper bags up-side-down near its ends. Hold one bag and heat the air in it with a lighted candle. Remove the candle and the bag will rise when it is heated. (The support stand and lever bar from the Welch Marine Demonstration Kit are excellent for this experiment).

J. Steam produces pressure. Place about two tablespoons of water into a small metal can with a close-fitting lid. The can should not be more than a half-pint size. Press the lid on firmly and heat the can until it is very hot. The lid will be forced to pop off the can by the terrific power of the steam.

K. Make a steam-jet reaction turbine. Find an empty can similar to those in which "Dry Gas" or soda pop is sold. Use a very thin nail to punch two thin opposite holes in the side near the top. Use the nail to bend the holes in opposite directions. Twist a screw-eye into the middle of the cork top and tie to the eye a long thread for a handle. Pour boiling water into the can to a depth of about one-half inch. Hold the can over an alcohol lamp from the thread, and soon two opposite steam jets will revolve the turbine rapidly.

L. Break the heads off from five or six match sticks and place them in a test tube. Wet a rubber stopper and put it in place not too tightly. Heat the test tube and watch the stopper "pop" caused by the expanding gases from the burst of flames.

M. Gasoline engine power stroke. (This demonstration to be performed by teacher only).
Secure a coffee can with a tight cover. (To make it tight, cut a 16 inch length of tape 1 inch wide. Fold it, wet it to prevent it from burning.
Punch a hole in the side of the can near the bottom and make the hole just large enough to admit a burning match without extinguishing it. Heat the bottom of the can for about five seconds to help vaporize the gasoline. Move the can away from the fire. Put in four drops of gasoline. Put the cover on tight. Wait a half minute to let the vapor mix with the air in the can. Put the butt end of a wooden match into one end of a soda straw and light the match. Put the lighted match into the hole and you will see and hear a fine power stroke.
CAUTION: Keep gasoline away from the heat. Use soda straw as a handle to the match because flame may shoot out from the hole.

N. Freezing water causes pipes and automobile radiators to burst. Secure a quart bottle and a two-hole rubber stopper that fits the opening. Insert a bent glass tube in one hole of the stopper and a thermometer in the other hole. Fill the bottle with very cold water. Insert the rubber stopper into the jar firmly so that water will flow nearly to the end of the tube. Place the bottle in a plastic bag. Now place the bottle in a metal pail. Pack finely crushed ice around the bottle adding salt. A mixture of two cups of ice to every cup of salt produces good freezing results. Note the thermometer goes down and the water draws back through the tube as the water contracts. Suddenly the water in the tube will come to a stop and then begin to flow into the tube again. The water in the bottle will get colder and colder, and begin to expand. This is what you would not expect to happen. The water will drip out of the tube until that in the bottle is frozen solid. The bottle may burst before the water does freeze solid. CAUTION: take safety precaution of placing bottle in plastic bag.

CONCEPTS -- Grade 6

III. Nature of Matter

A. All matter is part of, or derived from, the crust, oceans and atmosphere of the earth.
B. Atoms are matter and contain energy.
C. All substances upon the earth are made up of atoms which are ordinarily considered the smallest unit of matter.
D. An atom is made of electrons, protons, and neutrons.

E. Protons are positively charged particles, electrons are negatively charged particles, and neutrons are particles which are neither positively nor negatively charged.

F. The simplest atom, that of hydrogen, is composed of one proton, and one electron, the electron whirling around the proton in an energy level shell.

G. All other atoms are more complex than hydrogen atoms, they contain more protons and electrons than does the hydrogen atom, and also some neutrons.

H. By adding or subtracting protons or neutrons, scientists have learned how to change one kind of atom into another kind of atom.

I. These changes require great amounts of energy. Energy so released is called atomic energy.

J. When two or more very light atoms are combined to form heavy atoms, energy is released. (This is the type of energy which is produced upon the sun and in hydrogen bombs.)

K. Very large atoms, such as those of uranium and radium, are unable to hold together well, and therefore constantly are breaking up, giving off radiation and other forms of energy as they do so.

L. Men have learned how to split some of these very large atoms into smaller atoms, under certain conditions, with the accompanying release of great amounts of energy. (It is this type of energy which is found in nuclear reactors in atomic bombs.)

M. Scientists have developed means of controlling the extent of atom splitting in devices called reactors.

N. When placed in reactors, many substances temporarily become radioactive. These radioactive substances, which are called radioactive isotopes, have many uses in science and industry.

O. Because the energy production within reactors can be controlled these devices are not being used increasingly as sources of energy for power and for other purposes.

ACTIVITIES -- Grade 6

III. Nature of Matter

A. Concepts from Grade 5 may have to be reviewed and re-taught before beginning this unit. Because of the nature of the material, pupil activities for the sixth grade concepts are limited. Perhaps committees may be formed for library research.

B. Make models of atoms using wire, various colored beads, and foam blocks. Use different colored beads for the electrons, protons, and neutrons.

C. Collect at least eight mousetraps. Set each trap and place it carefully in the bottom of a large box. Place two corks (or ping-pong balls) on the wire arm of each trap. Use extreme care in doing the last step. Then drop one cork in the box. This cork represents a neutron shooting toward uranium atoms. As the cork springs a trap, the two corks (neutrons) on the wire will shoot out and spring other traps. If one of each pair of corks springs a trap, the "chain reaction" will continue until every trap is sprung. Sometimes, however, the reaction stops before all the traps are sprung. This can happen also in a nuclear chain reaction if the conditions are not right.

CONCEPTS -- Grade 6

IV. Machines

A. Simple machines were used by early man.
   1. Stone age (rollers, wheels)
   2. Christian era (screw, pulley, windlass)
   3. Egyptians and Babylonians (wheels, inclined plane, lever)

B. Levers are of three classes.
   1. In the first class the fulcrum is between the force applied and the force overcome. (scissors, balance)
   2. In the second class the force overcome is between the fulcrum and the force applied (wheelbarrow, claw hammer)
   3. In the third class the force applied is between the fulcrum and the force overcome. (firetongs, grass shears)

C. Pulleys can be fixed or movable with the movable pulley having the most mechanical advantage.

D. An inclined plane is used to move objects to a higher level. The steeper the plane the greater the force needed to haul the load up the incline.

ACTIVITIES -- Grade 6

IV. Machines

A. Study the history of machines. Make a mural to show this graphically.

B. 1. Observe machines at the following places in the community: fire station, bakery, dairy, power plant, newspaper, telephone exchange, and farm machinery store.
   2. Make diagrams of the three classes of levers showing the location of the fulcrum, weight, and force.

C. Keep a notebook with a list of machines with pulleys used in your neighborhood and school.
Make a box with wheels to show how friction is reduced.
Rub pieces of wood, rubber, iron, and paper together to show how friction causes heat.

D. 1. Make an inclined plane of wood, run water over it and float small pieces of wood down it.
   2. Pull a small wagon loaded with rocks up a slanted board using a spring balance on the end of the wagon to record the amount of force.

CONCEPTS -- Grade 6

V. Earth and Universe - Beyond the Earth

A. By studying the sky through thousands of years, people have discovered that there are changes from day to day which follow an orderly pattern.

B. Early people had sky watchers who were able to tell the coming of the seasons by the position of the sun and the stars.

C. The sun's position, which changes from day to day, repeats the pattern year after year.

D. Astronomers are scientists who study the stars and planets, to find out what they are made of and how they move and change.

E. The solar system is made up of the sun and the planets that revolve around it.

  1. The earth is one of the planets.
  2. The stars are not part of our solar system.
  3. The planets circle around the sun at different speeds.
  4. When a planet is nearer to us it looks larger and brighter.
  5. The planet nearest to the sun is millions of miles away from it.

F. The telescope is the chief instrument of the astronomer.

  1. A refracting telescope consists of a long tube with a glass lens, or several lenses, at each end.
     a. The lenses have different magnifying powers.
     b. Together they enlarge the image of a distant object.

G. A reflecting telescope has a large, round, curved mirror which reflects the light of distant objects to a lens.

H. Astronomers use the telescope as a camera lens and take pictures of stars on photographic film.

  1. A film can "see" more than the human eye, because photographic film can "soak up" light. The longer the exposure, the brighter the picture.

I. With the help of special instruments, scientists can measure the temperature of many distant bodies.

J. Scientists can estimate the temperature of glowing stars from the color of the starlight as seen through a telescope.

  1. A telescope lens can gather heat rays from a planet.
  2. Scientists can calculate the temperature of a planet if he knows its distance from the lens, the size of the lens, and the rise in temperature in his instruments.
  3. When a substance is heated hot enough, it glows.
  4. It glows and changes color as the temperature rises.

K. Scientists can measure the distance to various planets by sighting them from two opposite places on the earth.

L. Tiny planets called Asteroids or Planetoids travel around the sun in an orbit between Mars and Jupiter.

M. Bits of rock or metal in the sky are called meteors, or "shooting stars."

  1. When meteors fall toward the earth, their speed is so great that they are heated to a brilliant glow by friction with the air.
  2. Larger meteors which reach the earth without burning out are called meteorites.

N. Comets look like glowing balls with long fiery tails.

O. The home of the solar system is in a huge cluster of stars called a galaxy.

  1. Our solar system is much nearer to the rim than it is to the center of our galaxy.

2. The rim of our galaxy, which looks like a long, thin cloud in the sky, is called the Milky Way.
3. There are millions of galaxies besides ours.
4. Most galaxies are so far away that a whole galaxy looks like a single fuzzy star.

P. Because the sky distances are so great, astronomers have chosen the light-year, which is a much larger unit of measuring than the mile.

Q. A light-year is the distance that light travels in one year.

ACTIVITIES -- Grade 6

V. Earth and Universe - Beyond the Earth

A. Experiment to find out how two lenses are used in a refracting telescope:
Method: You will need two magnifying glasses. These must have different magnifying powers, one much more powerful than the other. To tell how much they differ, hold the lenses side by side, a few inches away from an open book. Does the print seem larger through one than the other? If so, this lens has the higher magnifying power. Now hold the two lenses face to face, with the higher-powered lens about an inch from your eye. Look through the two lenses. Move the outer lens away, slowly, until you see a clear image through both lenses. Notice that the image is enlarged and that it is upside down.

B. Experiment to show how a reflector telescope works:
Method: You will need a magnifying mirror. This looks like an ordinary round mirror, except that it is slightly scooped out, instead of being flat. You can buy such a mirror in almost any five-and-ten-cent store or hardware store. Choose a day when the sun is shining brightly, but not in the room. Pull down all the window shades except one. Stand about three feet from the window with the magnifying mirror facing it. Move the mirror back and forth and to the side until you get the right distance for that mirror. When you do, you will see an upside-down picture on the wall next to the window. It will be a picture of the clouds, houses, and other things in the distance.

C. Experiment to see why time-exposure photographs are valuable to astronomers:
Method: You will need a camera and a roll of film. The camera should be of the kind that can be set for a time exposure. Most cameras have such a setting. Take the camera into a place with very dim light. A fairly dark cellar will do. Set the camera on a firm support, such as a chair or table. Then take the following pictures of the place:

1. A snapshot. This allows a very brief flash of light to fall on the film.
2. A one-second time exposure.
3. A ten-second time exposure.
4. A sixty-second time exposure.

When the film is developed and printed, the first picture should be very dark and the last picture very light. The longer the exposure, the brighter the picture. This is because photographic film can (soak) up light.

D. Experiment to see how distant temperatures in space are measured:
Method: You will need a magnifying glass. This will be your light-gatherer, like the lens of a telescope. You will also need a bright electric light and a thermometer a few feet away from the electric light and read the temperature. After two minutes, read the temperature again. Write down the before-and-after temperatures. You will find that there is a slight rise. Then hold the magnifying glass so that it brings the light to a point on the bulb of the thermometer. What happens? You will find that the temperature goes up several degrees. The heat rays from the electric bulb were bent together by the lens and focused right onto the thermometer bulb. The thermometer showed a rise in temperature. You might like to try this experiment with some other source of heat, such as a candle, a gas flame, or an electric heater. If you use an electric heater, watch the thermometer and take it away if the line gets near the top. Keep a record of your findings.

E. Experiment to see how a scientists can estimate the temperature of a distant object from the color of that object:
Method: You will need an iron nail, pliers, and a gas flame. With the pliers, hold the nail in the flame. Watch the changes in color as the temperature of the nail goes higher and higher. First, it is the natural blue-gray color of a nail. Then, as it begins to get hot it becomes a very dull red, then brighter and brighter red, then orange, and yellow. If you could heat it hot enough, it would change still further to white, and to blue-white.

F. Experiment to see how we can measure distance in space:
Materials: String 12 ft. long, a ruler, a soda straw, sheet of stiff paper that is four feet long and one foot wide.
Method: We will measure the distance from the front of the room to something on the back wall. We can pretend that there is no way of getting across.

1. Have two of your classmates hold the string stretched tightly at the front of the room, about two feet from the wall.
2. Go to the left end of the string. Place the soda staw across it. Sight through the straw at the object on the back wall.
3. While you sight through the straw, let somebody bring the paper under it, so that the narrow side is lined up with the string. The left corner of the paper is at the place where the string and the soda straw cross each other. With the straw as a guide, draw a line on the paper.
4. Now go to the right end of the string and repeat step 3. This time the line is drawn from the right corner of the paper.
5. With a ruler or a yardstick, finish out each line so that the two meet.
6. Now draw a line from the meeting place straight back to the bottom of the paper. Measure this line. Let us say this line measures 32 inches. Change the inches to feet and you have your answer. The distance from the string to the object on

the back wall is 32 feet. You have measured the distance without crossing the room which is supposed to be empty space. Now check your measurements with a yardstick. How close did you get? (You changed inches to feet because the paper is 12 inches wide while the string is 12 feet long).

G. Experiment to orient children to space:
Method: Children may be taken to a place where there is a good open view; one which will allow distant observation. They may be taken to this same place a number of times during the year. As discussions relating to their experience develop, a globe may be used to indicate what a little bit of the total earth they look at. This is an experience which can be repeated many times during the year with the same group, as well as with groups at various levels.

H. Correlate Mathematics using speed to build an appreciation for distance:
Method: Older children might be encouraged to estimate how long it would take to travel the 93,000,000 miles by various methods of transportation. The speed will, of course, vary. For example, a passenger plane may have a speed of 300 miles an hour but some of the newer planes equipped with jet engines will have speeds in excess of 700 miles per hour. When the means of transportation is specified, the older children may do the long division themselves.

CONCEPTS -- Grade 6

VI. Air, Weather, and Climate

A. Air masses are characteristic of the regions in which they are formed.
  1. Polar Continental Air Mass.
  2. Tropical Gulf Air Mass.
  3. Polar Pacific Air Mass.

B. Air masses affect the regions over which they pass.

C. The place where two masses of air meet is called a front.
  1. A cold front occurs when a cold mass of air moves against a warm mass of air.
  2. A warm front occurs when a warm mass of air moves against a cold mass of air.

D. An occluded front occurs when two cold masses of air trap a warm front between them.

E. Temperature at which water vapor condenses into droplets of water is called the dewpoint.

F. When a liquid evaporates it cools the thing from which it is evaporating.
  1. Some liquids evaporate faster than others.
  2. Cooling is increased by faster evaporation.

G. Thunderstorms occur when moist, warm air rises, cools and condenses.
  1. Droplets of water fall as rain if too heavy to remain in the air.
  2. Lightning occurs when electrical charges build up in clouds.
  3. The quick expansion of air heated by lightning causes thunder.

H. Hurricanes are violent tropical windstorms.
  1. They originate over tropical waters.

I. Tornadoes are violent windstorms that do much damage.
  1. They usually are found in temperate-zone areas.
  2. Tornadoes are characterized by a funnel-shaped cloud.

ACTIVITIES -- Grade 6

VI. Air, Weather, and Climate

- A. Develop, with the pupils, the understanding that air is like one continuous moving ocean. Some sections of air are cold; some are warm; come contain more moisture than others. Thus the atmosphere is made up of groups of air masses, each with its distinct characteristics.
  1. Polar Continental - Develop the understanding that his is a dry cool or cold air mass - it forms over land (little moisture) where there is a cold land surface.
  2. Tropical Gulf - Develop the understanding that this is a warm, moist air mass - it forms over water (much moisture) where the water is warm.
  3. Polar Pacific - Develop the understanding that this is a cool, moist air mass - it originates in Siberia and is modified to a cold, moist air mass in its long trips over water. During our winter, the entire country is frequently under the influence of this type of weather maker.
- B. Study weather charts, follow illustrated weather forecasts, etc. in order to learn that the various air masses determine weather on land.
- C. 1. Develop the understanding that a cold-front is usually an area of bad weather. Rain, gusty winds, thunder and lightning are characteristics. A cold front usually hugs the ground, forcing its way under the other air.
  2. Develop the understanding that a warm front is usually spread over a wider area than a cold front and passes more slowly. A warm front announces its coming. Observe clouds spread out in advance. As the warm front approaches, steady rain falls in advance of the front. There may be 2 or 3 days of rain preceding the front.
- D. Develop the understanding that the two cool-air masses try to come together, they are more dense, thus forcing the warmer (lighter air) up.
- E. Place a glass of cold water on a table; measure temperature at outside surface of glass where vapor is condensing.
- F. Place a small amount of rubbing alcohol in one shallow pan and an equal amount of water in a pan of the same size.
  1. Time evaporation process.
  2. Record respective temperatures.
- G. Learn to identify cloud formations and the various types of weather peculiar to them.
  1. Develop the understanding that as warm, moist air rises, it cools and the water vapor condenses forming droplets of water. As these droplets increase in size, they increase in weight; thus they fall.
  2. Develop the understanding that lightning is caused by attraction between positive charges, which have built up on the earth's surface being sought by the negative charges which have been built upon the underside of clouds.
  3. Develop the understanding that thunder is caused by the collision of billions of ionized atoms. They are brought together at high speeds by the expansion of hot air surrounding the intensely hot

path of the bolt of lightning.

4. Develop the understanding that hurricanes form only over water. They weaken quickly over land. A continuous supply of water vapor is essential for the beginning and continuation of a hurricane. Hurricanes build on an existing wave of low pressure. They may also be caused by surges in masses of tropical air from high pressure areas from the equator. These storms are seasonal and much study is yet needed for exact causes.

H. Develop the understanding that cyclones are caused by counterclockwise winds around low pressure areas. Tornadoes are easily identified by the funnel-shaped cloud but the paths are difficult to predict.

CONCEPTS -- Grade 6

VII. Conservation

A. Trees provide many of our needs.
B. A forest is a community of plants and animals.
C. Each part of a tree or other plant has a particular function.
D. Forests help build soil.
E. Life on the forest floor is abundant and varied.
  1. Forests help protect the watersheds and regulate stream flow.
  2. Forests help control soil erosion.
F. Forest vegetation influences climate.
G. Forests have many enemies: insects, diseases, fires, animals, and man.
H. Forests in Pennsylvania are in private, State, and Federal ownership.
I. An understanding of the value of woodlands in the farm economy is important.
J. Arbor Day and Conservation Week are designated by the Governor by proclamation.
K. Conservation of mineral resources (non-renewable resources) means man should make the maximum use of the minerals present in the earth with complete elimination of waste of these resources.
L. Rocks are divided into three major groups: igneous, sedimentary, and metamorphic.
M. Mineral deposits are divided into three general classes: metallic, nonmetallic, and fuels.
N. Pennsylvania's mineral industry is very important.
O. Mineral deposits exist in the earth's crust in fixed quantities which are not evenly distributed throughout the world.
P. Metallic minerals have many uses.
Q. The location of mineral resources influences the location of mineral industries.

ACTIVITIES -- Grade 6

VII. Conservation

A. Discuss things we get from trees. List things made from wood, such as pencils. List things which are wood products, such as paper, plastics, etc. Trees provide shade, shelter, and beauty. Collect pictures which show these things.

B. A forest is like a city - nature's city - constructed and peopled with trees, insects, shrubs, mammals, herbs, bacteria, and a myriad of other living things.
   1. Take a walk in a forested area. Note trees, ground cover plants, worms, insects, and salamanders to be found.
   2. Observe and list the different kinds of trees on the schoolgrounds or your street.
   3. Have children bring in fruit and twigs with leaves on them so that they may study the characteristics of the leaf, bark, fruit, and twig.

C. 1. Discuss the parts of a tree or other plant: roots, stem, (or trunk), branches, buds, leaves, flowers, and fruit.
   2. Make a leaf collection.
   3. Make leaf blueprints.
   4. Make a plaster cast of a leaf.
   5. Make spatter prints of leaves.
   6. Make stamp pad prints.
   7. Decorate the room with colored leaves.
   8. Make a twig collection.
   9. Make a map showing trees on your schoolgrounds, park, or street.

D. The leaves and trees themselves, if not otherwise utilized, decompose into particles furnishing fertility and loose texture to the soil.

E. Get a sample of the forest floor, and spread it on white paper the size of a newspaper. Examine it for living organisms.

F. Forested watersheds help to stabilize the flow of water throughout the year by storing it when it is abundant and releasing it gradually.
   1. Trees may be planted on banks of streams and in gullies to sustain the soil. Examine a gully that has been planted and compare it with one that has not.
   2. Make arrangements to help plant a gullied field with trees to prevent soil erosion.

G. A forest, or any area of trees, is cooler, more shaded, and more moist than open areas on hot summer days. In winter, a woodland affords some shelter from the wind and is therefore somewhat warmer.
   1. Compare the temperature, humidity, and wind velocity in a forested area with similar conditions in an open area.

H. 1. Prepare a list of the chief enemies of the forest.
   2. List the causes of fires. (over 9/10 caused by man.)
   3. List diseases of trees. Collect specimens of disease or insect damage to twigs or leaves.
   4. Write for Junior Forest Ranger Handbook, and Smokey the Bear materials, available from U. S. Forest Service and the Pennsylvania Department of Forests and Waters.
   5. List the animals that live in the forest.

I. Private holdings amount to 78 percent of total forest area. State ownership amounts to 18 percent. Other 4 percent is public ownership.
   1. Visit a nearby forest.

J. Farm woodlands produce lumber and fuelwood, protect watersheds, grow wildlife, and supply places for recreation.
   1. Visit a nearby lumberyard or lumbering site.

K. 1. A list of flowers that may be picked and those that should be protected may be secured from the Department of Agriculture or the Department of Forests and Waters.

2. Plan a field trip or some other activity that emphasized conservation. A study of wild flowers would be timely. Learn about the Pennsylvania state flower, the Mountain Laurel, and the state tree, the Hemlock. A colored chart of the "Pennsylvania Official State Flower, Tree, Bird, and Animal" is available from the Pennsylvania State Game Commission - 75¢.

L. Practical conservation of mineral resources involves 3 main concepts: (1) waste must be eliminated. (2) we must find substitutes in new materials. (3) more complete exploration.
   1. List products formerly made of metals that are now being made of plastics.
   2. Be familiar with rocks and minerals and be able to identify several common rocks and minerals.

M. 1. Students should be able to identify and classify common rocks in each of the 3 main groups, igneous, sedimentary, and metamorphic.
   2. Display several rocks of each group so that the students may examine them.
   3. Have the students find the various minerals in an igneous rock such as granite.
   4. Have students collect and identify two or three rocks of each of the 3 groups.
   5. Rock and mineral specimens are available in a small labeled box from the Pennsylvania Geologic Survey Department of Internal Affairs, Harrisburg.
   6. Make a map showing the location of Pennsylvania's mineral industries that use rock as their raw materials. (Brick plants, glass plants, slate quarries, cement plants, lime plants, sand and gravel plants, and steel plants.)
   7. Visit one of the plants listed above.
   8. Take students to visit a museum to see a rock and mineral collection. This list is available from the Pennsylvania Geological Survey, Harrisburg.

N. Discuss definitions of metallic, nonmetallic, and fuels. Learn to identify common examples of each.

O. List rock and mineral products that are produced in our state.
   1. Students should discuss this topic more fully.
   2. Make a chart listing metallic minerals with pictures or drawings of the products made from each. Examples: magnetite - iron railroad rails, steel bridges, cars; graphite - lead pencils, crucibles; copper - copper tubing, copper wire, pennies.
   3. List everything in the schoolroom or home which is made from minerals or mineral fuels.

P. Discuss conservation methods for conserving our metallic minerals.

Q. 1. Make a location map of the major metallic mineral deposits in our state. Then make a location map of Pennsylvani's nonmetallic mineral industries and compare the two maps. Students will soon see the close relationship of these two maps and see that much of Pennsylvania's industry is dependent on the rich natural resources.

2. Locate on a map those industries that are dependent on distant sources of minerals.
3. Study the location of bituminous and anthracite coal in our state. Study the origin of these fuels.
4. Study fossils in general. Free small sets of Pennsylvania's fossils are available to the teacher from the Pennsylvania Geological Survey, Harrisburg.
5. Ask the Geological Survey where there is a fossil deposit near your school. Have students collect their own fossils if possible.
6. Have individual students report on the origin of coal, oil, and gas.

R. 1. Know the important coal areas of Pennsylvania. Make maps of the coal fields. A large-scale full-color map of the Coal Fields of Pennsylvania may be purchased from the Division of Documents, 10th and Market Streets, Harrisburg. (50¢ plus tax)
2. Similar maps of the State's oil and gas and coal fields on an 8½x11" sheet and in black and white are available, in quantity, free-of-charge, from the Pennsylvania Geological Survey, Harrisburg.

REFERENCE BOOKS FOR TEACHERS

Blough, Glenn O. It's Time for Better Elementary School Science. National Science Teacher's Association, National Education Association, 1201 Sixteenth St., N.W., 1958.

Blough, Glenn O., and Huggett, Albert J. Methods and Activities in Elementary Science. Dryden, 1951.

Blough, Glenn O. You and Your Child and Science. Department of Elementary School Principals, National Science Teacher's Association, 1963.

Burnett, R. Will. Teaching Science in the Elementary School. Rinehardt, 1953.

Calandra, Alexander. A Language Arts Introduction to Mathematics and Science. Washington University, St. Louis, Missouri, 1960.

Craig, Gerald S. Science for the Elementary School Teacher. Ginn, 1958.

Craig, Gerald S. What Research Says to the Teacher. Science in the Elementary School. Department of Classroom Teachers, National Education Association, 1201 Sixteenth St., N.W., Washington, D. C., 1957.

Dean, Peter M., and Mills, Lester C. Problem-Solving Methods in Science Teaching. Bureau of Publications, Teachers College, Columbia University, New York,1960.

Dunfee, Maxine, and Greenlee, Julius. Elementary School Science: Research, Theory and Practice. Association for Supervision and Curriculum Development, Washington, D. C., 1957.

Forty-Sixth Yearbook of the National Society for the Study of Education. Part I, Science Education in American Schools. University of Chicago Press, 1947.

Freeman, Kenneth, et. al. Helping Children Understand Science. Winston, 1954.

Greenlee, Julian. Better Teaching Through Elementary Science. Dubuque, Ia., Wm. C. Brown, 1954.

Heller, Robert L. Geology and Earth Sciences Source-book. American Geological Institute, Holt, Rinehart and Winston, 1962.

Huber, Clark. Working with Children in Science. Houghton, 1957.

Jacobson, Willard J., and Tannenbaum, Harold E. Modern Elementary School Science, A Recommended Sequence. Bureau of Publications, Teachers College, Columbia University, New York,1961.

Leeds, Willard L. Weather and Youth. American Education Publications, Columbus, 16, Ohio. 1956. (15¢)

Navarra, John G., and Zafforoni, Joseph. *Science Today for the Elementary-School Teacher*. Row, Peterson and Company, New York, 1961.

Navarra, John G. *The Development of Scientific Concepts in a Young Child*. Teachers College, Columbia University, 1955.

Piltz, Albert. *Science Equipment and Materials for Elementary Schools*. U.S. Department of Health, Education, and Welfare, U.S. Government Printing Office, Washington, D. C., 1961.

Piltz, Albert, and Gruver, William J. *Science Equipment and Materials: Science Kits*. U.S. Department of Health, Education, and Welfare. U.S. Government Printing Office, Washington, D. C., 1963.

Science for Today's Children. Thirty-Second Yearbook Number, Bulletin of the Department of Elementary School Principals, Washington, D. C. National Education Association, 1953.

Science in the Elementary School, The National Elementary Principal, Vol. 29 No. 4, February, 1950. Washington D.C.: Department of Elementary School Principals, National Education Association.

Shapp, Martha G. *Planning and Organizing Science Programs for Elementary* Schools. The Grolier Society, Inc., New York, 1961.

Sheckles, Mary. *Building Children's Science Concepts*. Teachers College, Columbia University, 1958.

The Fifty-Ninth Yearbook of the National Society for the Study of Education. Part I, *Rethinking Science Education*. Chicago: University of Chicago Press, 1960.

Thirty-First Yearbook of the National Society for the Study of Education. Part I, *A Program for Teaching Science*. Bloomington, Illinois: Public School Publishing Co., 1932.

Zafforoni, Joseph, and Selberg, Edith. *New Developments in Elementary School Science*. National Science Teacher's Association, National Education Association, 1963.

SCIENCE TEXTBOOKS

Allyn and Bacon - Thurber
Grades 1-6 - Exploring Science

American Book Company - Jacobson, Lauby
Grades 1-6 - A B C Science Series

Harper and Row - Navarra, Zafforoni
Kdg. Today's Basic Science: Now You Do It (charts)
Grades 1-6 - Today's Basic Science

Heath Company - Schneider
Kdg. Kindergarten Science Charts
Grade 1 - Science for Work and Play
Grade 2 - Science for Here and Now
Grade 3 - Science Far and Near
Grade 4 - Science in Your Life
Grade 5 - Science in Our World
Grade 6 - Science for Today and Tomorrow

Ginn and Company - Craig
Grade 1 - Science Near You
Grade 2 - Science Around You
Grade 3 - Science Everywhere
Grade 4 - Discovering with Science
Grade 5 - Adventuring in Science
Grade 6 - Experimenting in Science

Lippincott - Smith
Grade 1 - Along the Way
Grade 2 - Under the Sun
Grade 3 - Around the Clock
Grade 4 - Science Across the Land
Grade 5 - Through the Seasons
Grade 6 - Science Beneath the Skies

Lyons and Carnahan - Bond, Bond, Clymer, and Bell
Primer - Getting Ready
Grade 1 - Looking at Science
Grade 2 - Thinking About Science
Grade 3 - Knowing About Science
Grade 4 - Experimenting in Science
Grade 5 - Living with Science
Grade 6 - Looking Ahead with Science

Macmillan Company - Barnard, Stendler, Spoch, and Moffit
Grades 1 - 6 - Macmillan Science/Life Series

Rand McNally - Baker
Grade 2 - Around the Corner
Grade 3 - In Your Neighborhood
Grade 4 - Science Across the Land
Grade 5 - Far and Wide
Grade 6 - Your Science World

Scott Foresman - Beauchamp, Blough, Marshall, and Bailey
Kdg. - Science Is Wondering (charts)
Grade 1 - Science Is Fun
Grade 2 - Science Is Learning
Grade 3 - Science Is Exploring
Grade 4 - Science Is Experimenting
Grade 5 - Science Is Discovering
Grade 6 - Science Is Adventuring

Singer Company - Frasier, MacCracken, and Decker
Primer - We Ask
Grade 1 - We Look and Listen
Grade 2 - Seeing New Things
Grade 3 - Finding Answers
Grade 4 - Exploring Together
Grade 5 - Doing Experiments
Grade 6 - Solving Problems

Winston Company - Dowling, Freeman, Lacy, and Tippett
Grade 1 - I Wonder Why
Grade 2 - Seeing Why
Grade 3 - Learning Why
Grade 4 - Explaining Why
Grade 5 - Discovering Why
Grade 6 - Understanding Why

SCIENCE MAGAZINES, PAMPHLETS, AND BULLETINS

Basic Science Education Series. Row, Peterson, Evanston, Illinois.

Cornell University Rural School Leaflets. Cornell Rural School Leaflet Office, Cornell University, Ithaca, N. Y.

Earth and Sky. Outdoor Publishing Company, Box 589, Pasadena, California.

Elementary School Notes. Ginn and Company, 72 Fifth Avenue, New York 11, N.Y.

Science and Children. National Science Teacher's Association, 1201 Sixteenth Street, N.W., Washington, D. C., 20036.

Science Education News. American Association for Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington 5, D. C.

Science in Action. Pennsylvania Writing Conference, Department of Public Instruction, Harrisburg.
  No. 1 A Guide for Teaching Science
  No. 2 Measurement
  No. 3 Simple Machines
  No. 4 Geology
  No. 5 Force, Energy, and Power
  No. 6 Simple Plants and Animals
  No. 7 Insects and Spiders

Science News. Allyn and Bacon, Boston 11, Mass.

Science Service Bulletin. D. C. Heath, Englewood, N.J.

Science World. Science World, 33 W. 42 Street, New York 36, N.Y.

Singer Science News. 249-259 W. Erie Blvd., Syracuse 2, N.Y.

Ward's Workshop Notes. Ward's Natural Science Establishment, Inc. P.O. Box 1712, Rochester, N.Y., 14603.

Weekly Reader. (Science Reading Adventures) Education Center, Columbus 16, Ohio.

SCA Free and Low Cost Science Materials

REQUESTS FOR MATERIALS SHOULD BE SENT DIRECTLY TO THE LISTED ORGANIZATIONS, NOT TO SCA.

Academy of Natural Sciences, 19th and the Parkway, Philadelphia 3, Penna. The Magazine of the Academy, "Frontiers." Natural history for the informed layman and advanced young persons. Five times a year. Single copy, 50¢. One year, $2.50. Three years, $7.50.

Acheson Colloids Company, Division of Acheson Industries, Inc., Department 858, 1635 Washington Ave., Port Huron, Mich.: Free: The ABC's of Colloidal Dispersions, a 12-page booklet which provides the answers to many of the questions frequently asked about colloids. Sections of the booklet include - What is Graphite? - What is Colloidal Graphite? - Why Do we Disperse Graphite in Various Fluids? - What is Molydenum Disulfide? - How is Molybdenum Disulfide Different from Graphite?, etc.

Aetna Life Affiliated Companies, Information and Education Dept., Hartford 15, Conn.: Free: (in reasonable quantities) Booklets on: Home Safety, Fire Prevention, Highway Safety, Artificial Respiration. *Free: Film catalog - Safety Films.

Aircraft Industries Association of America, Inc., 610 Shoreham Building, Washington 5, D.C. Free: Guided missiles booklet analysing the entire missile field. Free: to teachers only--Seven three-color wall charts on missiles, space and man, speeds and altitudes, flight, etc. Free: to science and engineering teachers and guidance counselors only: Booklet, Career Opportunities in the Aircraft Industry.

Allegheny - Ludlam Steel Corp., Oliver Bldg., Pittsburgh 22, Pa. *Free: List of films on welding, steel production, making dies, corrosion, etc.

Ross Allen's Reptile Institute, Silver Springs, Fla.: Free: Price List of Pet Reptiles, Price List of Nature Books and Selected Publications. For sale: Keep Them Alive! An Important book for the amateur reptile collector, herpetologist, biology teacher, etc., $1.00 - The Story of Florida's Seminole Indians, $1.00.

Allied Radio Corp., 102 N. Western Ave., Chicago 80, Ill.: Radio Builder's Handbook, 25¢. Dictionary of Electronic Terms, 25¢: Radio Circuit Handbook, 25¢: Electronics Data Handbook, 35¢: Coil Winding Calculator, 50¢: Parallel Resistance and Series-Capacitance Calculators, 35¢: This is High Fidelity, 10¢: Built-in Hi-Fi Systems, 10¢.

Allis-Chalmers Manufacturing Co., Box 512, Milwaukee 1, Wis.: farm activities youth activities, travel areas and phases of electric power. Write for details. Free booklet: Story of Power Generation, in color, includes descriptive material.

Aluminum Company of America, Pittsburgh 19, Pa.: Free Booklet: Alcoa

Informational Aids, lists, free booklets, visual aids, and sound motion pictures.

American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington 5, D.C.: The Traveling High School Science Library, an annotated catalog of 200 science and mathematics books suitable for recreational and collateral reading by high school students, 25¢ (25 or more copies to one address sold at one-third discount). An Inexpensive Science Library, a list of paperbound science and mathematics books selected for high school students and non-specialist adult readers, 25¢ (25 or more copies to one address sold at one-third discount). Science, the official weekly journal of AAAS distributed to members and of interest to exceptionally bright students, $8.50 per year. A comprehensive list of science and mathematics books for secondary school and community libraries, which also serves as a student reading guide, $1.00.

American Association of Colleges of Pharmacy, SCA, 833 S. Wood St., Chicago 12, Ill.: Booklet: Shall I Study Pharmacy? Opportunities and educational requirements in Pharmacy, 35¢, 3 for $1.00. *Films: See Sterling Movies listing.

The American Association of Medical Milk Commissions, Inc., 405 Lexington Ave., New York 17, New York: Free Publication: What is Certified Milk?

The American Association of Medical Record Librarians, 510 N. Dearborn St., Chicago 10, Ill.: Free: Brochure entitled--About to Choose a Career-Choose Medical Record Library Science-describing work of medical record librarian. Magazine: Journal of American Association of Medical Record Librarians - published bimonthly. $3.00 per year: $5.00 for two years.

American Association of Nurse Anesthetists, 3010 Prudential Plaza, Chicago 1, Ill.: Free: Anesthesia A Special Type of Nursing. Information primarily prepared for use by nursing school students, but also available to others who are interested. Free: Nurse Anesthetist-Career. Information primarily designed for high school students, but also available to others who are interested. Free: Approved School For Nurse Anesthetists. Revised semi-annually.

The American Association of Variable Star Observers, Dept. SCA, 4 Brattle St., Cambridge 38, Mass.: A world-wide group of amateur and professional astronomers that reports the fluctuations of the strange variable stars; a project of great scientific value. Booklet: A Manual for Observing Variable Stars, $1.00. Contains complete observing instructions, and sample practice charts of the star regions. Also included are lists of star atlases, astronomy books and magazines, and other useful material.

American Astronomical Society, C/O J. A. Hynek, Sec., Smithsonian Astrophysical Observatory, 60 Garden St., Cambridge 38, Mass.,: Free leaflet: A Career in Astronomy.

American Bosch Arma Corp., Springfield,7, Mass.,: Booklet: Operation and Maintenance of American Bosch Fuel Injection Equipment, 40¢. Chart: Cutaway View of the Fuel Injection System, $2.00.

The American Ceramic Society, 4055 N. High St., Columbux 14, Ohio: Free: Brochure describing the work of a ceramic engineer in aircraft industry, structural clay products, refractories, whitewares, electronics, glass, porcelain enamels, abrasives, cements, and nuclear energy fields. Ask for Ceramic Engineering --A Key Profession in the Atomic Age.

American Chemical Society, 115 16th St. N.W., Washington 6, D.C.: Free list: Departments of Chemistry and Chemical Engineering Approved by the A.C.S. Committee on Professional Training. Booklet: Careers in Chemistry and Chemical Engineering, 32 articles are included, each written by an expert, cover: selection of a career, training for it, making a sound start, and life time pursuits for men with chemical training, bibliograph of 175 books and articles, excellent material for students and counselors, $1.50. Bulletin: The Chemical Profession-An Educational and Vocational Guidance Pamphlet gives description of work, training, qualifications, compensation, opportunities, and other pertinent guidance information, 25¢. Pamphlet: Shall I Study Chemistry?--Briefly describes the profession and training and qualifications needed to enter it. Especially written for high school students. Single complimentary copies to individuals, larger quantities to non-profit organizations. Charge to industrial firms, etc., 5¢ per copy.

The American College of Radiology, 20 N. Wacker Dr., Chicago 6, Ill., Pamphlet: X-Rays Protect You, $6.00 per pack of one hundred. Twenty-four page, informal easy to read brochure which describes the medical aspects of radiation and the work of radiologists, the physicians who specialize in X-rays, radium and other radioactive substances in diagnosis and treatment of disease.

American Dental Association, Bureau of Dental Health Ed., 222 E. Superior St., Chicago 11, Ill. Free: Catalog of the American Dental Assn. lists literature, professional aids, special. Free pamphlets: Dentistry as a Professional Career.

The American Dental Hygienists' Assn. Bureau of Dental Health, 100 E. Ohio St., Chicago 11, Ill. Free information will be furnished on the Dental Hygiene Aptitude Testing Program. Publication: The Journal of the American Dental Hygienists' Assn., $2.00 per year.

The American Dietetic Assn., SCA, 620 N. Michigan Ave., Chicago 11, Ill. Career Posters: Dietetics . . . . A Career for Better Living, free -You are Equipped for Many Careers, 5¢. Booklet: Dietetics as a Profession. Complete description of the profession and career possibilities. Single copies free to sponsors; extra copies and to others, 25¢. Pamphlets: Academic Requirements for Active Membership in the American Dietetic Association and Entrance to Approved Dietetic Internships. Look Ahead, the Future is Bright, 5¢: Dietitians in Deamdn, 5¢: More, Please (normal nutrition and dental health for children), 3¢ (50 copies, $3.50; 100 copies, $5.00) Food Facts Talk Back (food facilities and facts), 50¢ (special price on quantities). *Film: View from the Mountain, on careers in dietetics.

American Forest Products Industries, Inc., 1816 N. St., N.W., Washington 6, D.C. Free: List of Teaching Aids for the study of our forest resources and their conservation. Listed are booklets, pamphlets, films and wall maps produced by AFPI. *Free Industry Bibliography of educational material on forestry and forest products available from other forest industry organizations and companies.

American Forestry Assn., 919 17th St., N.W., Washington 6, D.C.: Booklets: Trees Every Boy and Girl Should Know, 50¢ - Cartoon-type booklet, Forest Fire (up to 100 copies, 10¢ each). Books: Managing Small Woodlands, $1.00 -Conservation Chart, 60¢.

American Geological Institute, SCA, 2101 Constitution Ave., N.W., Washington 25, D.C.: Earth for the Layman, by Mark W. Pangborn, Jr., about 64 pages, 1957, $1.00 (payment must accompany order). An annotated listing of more than 1400 popular books on geology and related subjects. Free: Single copies of career booklet, Shall I Study Geological Sciences?

American Humane Education Society, SCA, 180 Longwood Ave., Boston 15, Mass: Leaflets: on the care and feeding of pets, such as rabbits (30¢ a dozen), dogs (50¢ a dozen), parrots and parakeets (25¢ a copy), cats (50¢ a dozen), turtles (40¢ a dozen,) horses (75¢ a dozen). Also material that suggests elementary school study units: Ways of Kidness (40¢ a dozen) Cruelty at Eastertime (40¢ a dozen) Nature Study in the Camp Program (30¢ a dozen) Animals Plays: The Kidness Train (80¢ a dozen), One Morning Long Ago (75¢ a dozen) - Teaching with Toads and Turtles (60¢ a dozen) - and others, Single sample copies of most leaflets free on request.

American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N.Y. Free Career Pamphlet: Indispensable Man, illustrated, 20 pages. Explanation to young men and women of pre-college age of opportunities in many fields of electrical engineering; advise on what kind of studies should be pursued in high school; list of universities and colleges in U.S. having accredited curricula leading to first degrees in electrical engineering; general description of college level courses in electrical engineering; types of work in each field and requirements leading to employment and the status of a licensed engineer; brief history of electrical engineering; definition of difference between engineer and scientist showing how their work is complemented by each other.

The American Institute of Family Relations, 5287 Sunset Blvd., Los Angeles 27, Calif.: Free: Descriptive Literature; list of inexpensive pamphlets on all phases of pre and post marital relations, personality problems, etc; sample copies of monthly bulletin, Family Life.

American Institute of Steel Construction, Inc., 101 Park Ave., New York 17, N.Y. Free Booklets: Prize Bridges-Structural Steel-Why Structural Steel Is Best for Schools-Parking in the Air with Structural Steel-Shopping Centers Framed with Steel. Quarterly Bulletin: Steel Construction Digest. (Free).

American Iron and Steel Institute, 150 E. 42nd St., New York 17, N.Y. Free booklets (in quantity lots): The Picture Story of Steel, nontechnical description of steelmaking in elementary terms-Steel Serves the Farmer, tells how greater use of steel has helped the farmer-Steel, from Mine to You, four-page diagram of principal iron and steel-making operations-Major Steps in

Steelmaking, black and white schematic layout-The Making of Steel, describes in detail the making of iron and steel. (One copy only).

American Medical Assn., SCA, 535 N. Dearborn St., Chicago 10, Ill.: Free catalog: Publications About Your Health. Lists a wide assortment of publications suitable for all age levels.

American Meteorite Museum, P.O. Box 446, Sedona, Ariz., Booklets: A Comet Strikes the Earth, 75¢ (Contains a sample oxidized meteorite)--Chips from The Moon, 35¢--Sparks form a Celestial Bomb, 15¢--Meteorite Crater Study Kit (contains authentic samples of meteoritic material), $1.25.

American Museum of Atomic Energy, Educational Section, P.O. Box 117, Oak Ridge, Tenn.,: Free to teachers: Science Fair Handbook, suggestions for guiding exhibit development, lists of projects for various age levels.

The American Museum of Natural History, Central Park West at 79th St., New York 24, N.Y.: For Loan: Circulating exhibits--Groups of birds, insects and animals; culture specimens. Catalog available, Dept. of Circulating Exhibitions. (Service limited to areas where transportation can be furnished by borrower). *Motion pictures--sound films for schools and organizations anywhere in the U.S. upon payment of rental fee. Catalog available. *Color slides, Filmstrips--2"x2" color slides in sets with scripts or recordings, or singly, for rental; some for sale. Standard glass slides in sets with script on natural history subjects free to N.Y.C. public and parochial schools; 2¢ per slide to other borrowers. Color filmstrips on Prehistoric Life and Birds for rental and purchase. Catalogs available, slide library. For sale: Popular publications--popularly written handbooks and science guides ranging in price from 5¢ to $5.75 on many phases of natural history. Catalog available, Man and Nature Publications.

American Nature Assn., Dept. SCA, 1214 15th St., N.W., Washington 6, D.C.: Free: Catalog of Publications. Listed are many items invaluable to sponsors of biology and nature clubs. Magazine: Nature, $5.00 per year.

American Petroleum Institute, Material Distribution Section, 50 W. 50th St., New York 20, N.Y. Free: Single copies of illustrated student booklets are available on: General Science; Social Studies, Physics, Chemistry, Conservation career opportunities, and--Economics of the petroleum industry. Materials available for teacher use include: Teacher's Handbook and Work Supplement, charts, film strips (with guides), and catalog, Movies about Oil. *Films and demonstrations available on loan. Teachers may also inquire about free literature in classroom quantities and ask for sample kits.

The American Potash Institute, 1102 16th St., N.W., Washington 6, D.C.: Free colored wall posters: Plant Food Utilization--Cotton Rust is Potash Starvation--Corn Starvation Symptoms--Potash-Starved Legumes. Free Reprints: The Salt that Nearly Lost a War--When Fertilizing Consider Plant-Food Content of Crops--How Different Plant Nutrients Influence Plant Growth--What's in That Fertilizer Bag?--Learn Hunger Signs of Crops--Starved Plants Show Their Hunger--The Development of the American Potash Industry--Fertilizer Placement--Potash Deficiency Symptoms--Hidden Hunger--Potash in Agriculture. Monthly Magazine: Better Crops with Plant Foods, 10¢ per copy.

American Radio Relay League, West Hartford 7, Conn.,. Free: Ham Radio for the Whole Family. List of ARRL Publications. General Information for Beginners. Learning the Radiotelegraph Code, 50¢--How to Become a Radio Amateur, 50¢--The Radio Amateur's License Manual, 50¢--Operating an Amateur Radio Station, 25¢. All of the above, $1.50.

American Society for Engineering Education, University of Illinois, Urbana, Ill.: Career Pamphlet: The Engineering Technician, a 20-page booklet describing the qualifications, education and work of engineering technicians. Single copies, 25¢ each. Report of Evaluation of Engineering Education, a 36-page booklet. Though not designed specifically for guidance purposes, discusses the modern objectives of engineering education and their implementation, faculties, curricular content, and factors influencing undergrate educational achievement. Single copies, 25¢ each.

American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio: Free: 95-page booklet, Your Career in the Metallurgical Profession, describes this field of engineering, with charts and graphs indicating different activities as well as salaries of metallurgists in all fields. Lists of schools. Single copies upon request from H.S. Science teachers, guidance counselors and other educational personnel. Free: Does Engineering Appeal to You?, a seven page accordion folded leaflet for distribution in quantities to H.S. students. Describes in Brief form the duties and opportunities in the metallurgical profession. List of schools.

American Society of Agricultural Engineers, SCA, P.O. Box 229, Saint Joseph, Mich.,: Free in reasonable quantities: Agricultural Engineering--A Challenging Career: Agricultural Engineering as a Professional Career.

American Society of Civil Engineers, 33 W. 39th St., New York 18, N.Y.: Free Pamphlet: You can be a Civil Engineer--and here's how to start!

American Society of Photogrammetry, 1515 Massachusetts Ave., N.W. Washington 5, D.C. Free: Leaflet describing the second edition of the Manual of Photogrammetry giving complete table of contents of this collection of operating instructions and engineering fundamentals of photogrammetry and current practices for construction of maps.

The American Society for Refrigerating Engineers, SCA, 234 Fifth Avenue, New York 1, N.Y.: Air Conditioning and Refrigeration Data Book--Design Volume, 1955-56 edition ($10.00 value for $1.98) This is the official reference volume of the American Society of Refrigerating Engineers and the text book for the air conditioning and refrigerating industry. Contains 39 chapters; 80 pages of text; 400 charts and diagrams, 117 pages of new data.

American Society of Tool Engineers, 10700 Puritan Ave., Detroit 38, Mich.,: Free informative pamphlets and brochures will be furnished covering tool engineering activities and opportunities. Some of the subject covered are career opportunities in tool engineering, a suggested curriculum in tool engineering, history of tool engineering, and the science of mass production.

Write for list. A free catalog of technical books, papers, research reports, standards and data sheets published by the Society is also offered.

American Standards Assn., 70 E. 45th St., New York, N.Y. Free cartoon book: Through History with Standards.

The American Sugar Refining Co., 120 Wall St., New York 5, N.Y. Free Book: The Story of Cane Sugar.

The American-Swedish News Exchange, Inc., 630 Fifth Ave., New York 20, N.Y. Free Leaflet: The Nobel Prizes.

The American Veterinary Medical Assn., 600 S. Michigan Ave., Chicago 5, Ill., Free Booklet: Veterinary Medicine As a Career, containing a listing of accredited schools, prerequisites for professional training and outlining career opportunities. Booklet, Pets for Assurance of a Fuller Life, by Equitable Life Insurance Society of New York, containing tips on pet care. Catalog of films available from the AVMA film library and other sources which includes a resume, the type of audience for which it is suitable and rental fee.

Amplifier Corp. of America, 398 Broadway, New York 13, N.Y.: Free: literature on our battery-operated, spring-motor magnetic tape recorders; Continuous Loop, Magnetic Tape Recorders.

Archaeological Institute of America, 5 Washington Square, N., New York 3, N.Y. Free Career pamphlet: Archaelogy as a Career, giving information relevant to becoming an archaeologist; course of study, employment opportunities, etc. Single copies free: bulk orders, $5.00 per hundred, plus $.75 postage.

Armstrong Cork Co., Lancaster, Pa.: Free leaflets: The Story of Linoleum--The Story of Cork. Free films: Quiet, Please! dramatizes use of acoustical material in the house. Beauty for the Yard, the story of how linoleum is made.

Asbestos, 807 Western Saving Fund Bldg., S.E., Cor. Broad and Chestnut St., Phila.,7, Pa. Booklets: The Asbestos Factbook, 25¢--Asbestos Mining Methods, 25¢--Milling Asbestos, 25¢.

Association Films, Inc. SCA, 347 Madison Avenue, New York 17, N.Y.: Free catalog: Listing over 1400 free loan and rental films—many of them excellent for science clubs and classes.

Association of American Geographers, National Research Council, Library of Congress, Washington 25, D.C.: Free: Single copies of A Career in Geography, prepared by a Joint Committee on Careers in Geography, of the Association of American Geographers and the National Research Council. It provides a guide to students who might be considering making geography their chosen profession. It outlines what geography is, what geographers do, where they work, and what remuneration they receive. Where to study, what should be included in a geographic curriculum, and the cost of professional training are also discussed.

Association of American Railroads, SCA, Transportation Building, Washington 6, D.C.: Free materials on railroad transportation, including: Cartoon-type booklets, The Wheels of Progress-Ride the High Iron--Rails Across America--Railroads Deliver the Goods; Clear the Track; Quiz on Railroads and Railroading--Chronology of American Railroads--American Railroads, Their Growth and Development--Inside Railroading--The Railroad Story (especially for students of science)--Railroads at Work, a picture book of the railroads in action--The Human Side of Railroading--The Day of two Noons--Wall Charts (set of three for sponsors only)--The Great American Railroad--Teacher's Kit for a Study of Railroad Transportation (for sponsors only) Free (one set per school) color slidefilms on railroading.

Association of Western Railways, 105 W. Adams St., Chicago 3, Ill.,: Free: Railroad Facts--Annual publication suitable for classroom use--upper grades, high schools, colleges, etc. Individual copies on request. Railroad Whistle Talk--copies on hand at all times. Suitable for all grades.

Astronomical League, Benjamin Adelman, Editor, 4211 Colie Drive, Silver Spring, Md.: Space Science, monthly bulletin (except July and Aug.). 50¢ a year for group subscriptions of 5 or more, 75¢ for individual subscriptions.

Atomic Industrial Forum, Inc., 3 E. 54th St., New York 22, N.Y.: Booklet: Youth's Opportunities in the Atomic Industry--(1958), based on proceedings of conferences for high school and college students on careers in the nuclear field. Talks in conferences for high school and college students on careers in the nuclear field. Talks in the report discuss the need for trained man power and include simplified explanations of nuclear technology and atomic energy applications. 40 pages, illustrated. Single copy price: 25¢ (remittance must accompany order) bulk prices: 100-499, 20¢ each; 500 and more 15¢ each.

Atomic Research Laboratory, 10717 Venice Blvd., Los Angeles 34, Calif.,: Att'n Librarian. Free Leaflets: Radioactive Isotope Price List (no AEC license required). Radiation Safety in Schools. Booklet: Laboratory Experiments with Radioisotopes for High School Science Demonstrations--75¢.

Audio Engineering Society, P.O. Box 12, Old Chelsea Station, New York 11, N.Y.: Free: List of Preprints of Convention Papers, AES Disk Standard TSA, Journal of the Audio Engineering Society--$8.00. Preprints--85¢ each nonmember, 50¢ each members. Journal free to members.

Automobile Manufacturers Association, 320 New Center Bldg., Detroit 2, Mich.

Free Booklet and Chart: The World Makes an Automobile, bulletin board map showing natural resources used in manufacture of motor vehicles. What It Takes to Make Your Car, a pictorial booklet describing automotive production processes--Bulletin Board Truck Map: color map showing principal products of each state, bordered by interesting types of trucks. Single copies available to teachers or librarians.

Bausch & Lomb Optical Co., Rochester 2, New York: Note: This material is available to accredited secondary school science teachers only. Free booklet: Bausch and Lomb Science Teaching Aids. Free Booklets: Bausch and Lomb Honorary Science Award and Science Scholarships--the Theory of the Microscope--Milestones in Optical History.

Behr-Manning Co., Div. of Norton Co., 959 Howe St., Troy, New York: Free booklets How to Sharpen--Coated Abrasives, Descriptions and uses--Plastics Reference Chart.

Bell Telephone System, (Send request to nearest Bell Telephone Company office). Free Booklets: The Magic of Your Telephone--The Telephone in America--Alexander Graham Bell--Mr. Bell Invents the Telephone--the Magic Behind Your Dial--The Story of the Transistor. Films are available, including Science Series films; consult your local Bell Telephone office about free loan arrangements.

Better Vision Institute, Inc., 630 Fifth Ave., Rockefeller Center, New York 20, N.Y.: Free Booklets such as: Why We See Like Human Beings--A Message to Mothers on Children's Eyesight--How We See--Eyes, First of All. Set of 8 free Science Classic brochures on eye phsiology and care.

The Black & Decker Manufacturing Co., Towson 4, Md.,: Free: Information of Electric Power Tools. Booklet: Router Manual--Your guide to finer woodworking, 50¢ per copy.

Boice-Crane Co., 977 W. Central Ave., Toledo 6, Ohio: Free pamphlet: Router Manual--Your guide to finer woodworking, 50¢ per copy.

The Borden Co., SCA, 350 Madison Ave., New York 17, N.Y.: Free chart: Journey of Milk Through a Pasteurization Plant. Free Leaflet: Story of Non-Fat Dry Milk. Free Booklet: Good Teeth Free Booklet: Milk----A vital food for folk of all ages. Motion picture film: Hail the Hearty, Teacher's Guide.

Bray Studios, Inc., 729 Seventh Ave., New York 19, N.Y.: Free: Two Films on parachutes showing their utilization in scientific research for military and civilian uses, aside from the primary role of saving life. Titles: Operation Survival and Packing and Maintenance of Parachutes. (Former available in Spanish, also on free loan.) A number of films such as swaging, for metalcraft students; Ignition and Spark Plugs, for driver training, etc., available on rental or purchase. (letter in Spanish also) for Catalog of Educational Films on science, health and hygiene, aeronautics and pre-flight training, etc., available on rental or purchase basis. (Some in Spanish)

Bristol-Meyers Co., Educational Service Dept., SCA 8, 45 Rockefeller Plaza, New York 20, N.Y.: Free: Dental Health and personal grooming teaching units. Includes Teacher's Manual, Wall Charts and Student Leaflet for distribution. Write for free listing. (Available only to teachers and club leaders.)

British Information Services, 45 Rockefeller Plaza, New York 20, N.Y.: Free catalogs: Government Publications on Education and on Scientific and Industrial Research.

Buffalo Museum of Science, Humboldt Park, Buffalo 1, N.Y.: Booklets: Constellation Charts, 20¢--The Butterflies of the Niagara Frontier Region and Beginner's Guide for Collecting, Bearing and Preserving Them, $1.15. Household Insect Pests Usually Found in the Niagara Frontier, 40¢--Terrariums, 10¢. Common Fossils of Western New York, 25¢. Magazine: Science on the March, 60¢ per year.

Calgon Company, Dept., SCA, P.O. Box 1346, Pittsburgh 30, Pa. Free Booklet: Calgon, Its Use In the Home--Calgon, A Chemical Development from a Non-Chemical Background--A Short Course in Water Conditioning.

California Redwood Assn., Sheldon Bldg., First and Market Sts., San Francisco 5, Calif.: Free Leaflets: The Olive, the World's Oldest Fruit--The Olive, Rich and Romantic--Questions and Answers About Ripe Olives.

California Redwood Assn., Sheldon Bldg., First and Market Sts., San Francisco 5, Calif. Free leaflets: Physiology of Trees--Tree Farms in Calif--Tree Farm, Selective Cutting--The Life and Habits of Redwood the Extraordinary. Film: The Forever Living Forests (color) For rental, write Ideal Pictures, Inc., 58 E. South Water St., Chicago 1, Ill.

The Canadian Embassy, 1746 Massachusetts Ave., N.W., Washington 6, D. C.: Free: Catalog of Publications, listing background information on Canadian affairs.

Capital Airlines, Inc., Washington National Airport, Washington 1, D.C.: Free Booklet: Tinkering with the Turbine, describing in laymen's language the principles of jet-prop airplane engine operation. Free Documentary film: A New Concept in Flight, dealing with the introduction of jet-prop Viscount airplanes into the American airways by Capital in 1955.

Cardinal Products, Inc., Dept. SCA, P.O. Box 1611, Durham, N.C.: Free: Wall Chart, An Outline of the History of Chemistry, and 1955 International Atomic Weights chart.

Cargille Scientific, Inc., 117 Liberty St., New York 6, N.Y.: Focusing negative for photographic enlarger use, set in a paper mask which can be trimmed to fit enlarger.

Carnegie Institution of Washington, Department of Genetics, Cold Spring Harbor, Long Island, New York. Free Booklet: A Guide to Introductory Studies of the Genetics, and Cytology of the Vinegar Fly, Drosophila melanogaster. (One copy per club, Order additional copies at 25¢ each from Carnegie Institution of Washington, 1530 P St., N.W., Washington 5, D. C.) Free cultures of live Drosophila for experiments described in above booklet. (Request must be accompanied by signature of club sponsor, as assurance that material will be used under guidance.)

Carolina Biological Supply Company, Inc., Dept. SCA, Elon College, North Carolina: Free: SCA Packet of Instructive Literature. Includes instructions for setting up an aquarium and a terrarium, as well as information on the care of chamaleons, turtles, and the like. Plastics Embedding Booklet, postpaid, $.50. Leaflets Describing: Beginners Set, for use in mounting biological specimens in clear plastic. Carolina Aquarium Assortment, Animals and Plants, with instructions. Slide Set, 12 carefully selected prepared microscope slides of various subjects.

The Carpenter Steel Co., Reading, Pa.: Book: Tool Steel Simplified, $2.00. A 564-page book illustrated with pictures, charts, diagrams and tables easily grasped by the student.

Carrier Corp., 300 S. Geddes St., Syracuse 1, New York: Free Educational Publications on air conditioning, refrigeration and industrial heating. Film: Service Unseen story of air conditioning. Write--Edward I. Make, Circulation Mgr., Modern Talking Pictures Service, Inc., 45 Rockefeller Plaza, New York 20, N. Y., giving dates and audiences. No charge.

Caterpillar Tractor Co., Peoria, Ill.: Free Booklets: Caterpillar Track Type Tractors--Wheel Tractors--Operators Handbooks--Informative booklets on Agriculture, Construction, Logging, Mining, Earth-moving and Diesel Engines. Current Maintenance Guides include: Track Type Tractors--Motor Graders-Wheel Tractors -- Diesel Engines.

Cereal Institute Inc., 135 S. LaSalle St., Chicago 3, Ill.,: Free (for sponsors only): TeachersSource Books on Breakfast and Breakfast Cereals.

Chamber of Commerce of the United States, Over 2000 Chambers of Commerce now have committees on Education. These committees have been alerted to the nation's manpower problems and to the need for better career planning by young people. Many Chambers have cooperated with school officials in planning and conducting "Career Conferences for Teen-agers." Business and profession men in every community are ready to work with teachers and administrators to improve guidance programs, to develop science fairs or to secure materials, equipment or work experience to make science teaching more effective. For further information about such business-education cooperation consult your local Chamber of Commerce or write to the U. S. Chamber of Commerce at 1615 H St., N.W., Washington 6, D. C.

Champion Spark Plug Co., Toledo 1, Ohio: Films: The Story of the Modern Spark Plug, How Champion develops, designs, manufactures and markets spark plugs for today's automobile, truck, marine and industrial engines. Take it From a Champion (Color Public Service and Entertaining) Driving safety habits demonstrated by professional race drivers on the track. Please consult Home Office, Toledo. Facts about Spark Plugs and Engines, 24-page booklet. Available in English as well as Spanish version.

The Chase Manhattan Bank Museum of Moneys of the World, RCA Building, Rockefeller Center, 1254 Avenue of the Americas, New York 20, N.Y. Free Booklet: Moneys of the World (a brief description of the material in the collection).

The Chemical Elements, Box 315, South Lancaster, Mass.,: A Wall Chart of the Chemical Elements (38" x 50") $1.00 each, postpaid.

The Chemical Rubber Company, 2310 Superior Ave., Cleveland 14, Ohio. Free: Literature on the 39th and the New 40th Edition of the Handbook of Chemistry and Physics, over 3300 pages of factual data on physics, chemistry and mathematics on special India paper. New 11th Edition C.R.C. Standard Mathematical Tables Text for applied mathematics assistance containing Differential Equations, Fourier Seriers and Fourier Transforms, Partial Fraction, etc. . . . . $2.00.

Chicago Natural History Museum, Dept. SCA, Roosevelt Road and Lake Shore Drive, Chicago 5, Ill. Free: Price list of illustrated popular series publications available from the Museum. These 75 leaflets and booklets range in price from 10¢ to $1.75 and cover a variety of subjects in the fields of anthropology, design, botany, geology and zoology. From the price list you can select and order such subjects as: Insect Musicians, Fifty Common Plant Calls, Prehistoric Man, Whitetailed Deer, Etc. Free: Price list of post card sets published by the Museum. Subjects are within the fields of anthropology, botany, geology, and zoology, and sets are priced at from 10¢ to $1.25 each. Sample subjects listed: Man of the Stone Age; Human and Animals Figures, New Guinea; Restoration of Ancient Landscapes, Plants and Animals: Apes and Monkeys. Mimeographed leaflets dealing with scientific careers; (4¢ stamp for each) A Career in Archaeology--A Career in Botany--A Career in Geology and Paleontology.

P. F. Collier & Son Corp., Liberty and Education Division, 640 Fifth Ave., New York 19, N.Y. Booklets: Space Satellites, Rockets & Satellites, Inventions, General Science Booklet, Career Guidance. Price: 1-9 copies 25¢--10 or more 10¢.

Connecticut Forest and Park Assn., 322 N. Main St., Wallingford, Conn.,: Pocket size paper-covered manual, Forest Trees Common to Southern New England and Adjacent Areas in New York State, price per copy 75¢. Price ten or more copies to one address, 60¢ per copy. Connecticut buyers should add tax.

The Conservation Foundation, 30 E. 40th St., New York 17, N.Y.: Free: Leaflet describing the purposes and work of the Foundation and listing its publications and educational films. Includes such publications as Forests for the Future (free)--A conservation handbook, 50¢--Concepts of Conservation, A Guide to Discussion, 25¢--Teaching Science Through Conservation. *Also lists films distributed through Encyclopedia Britannica Films, Inc., such as the Living Earth Series--Yours is the Land--The Living Forest--The Web of Life Series--The Elementary Conservation Series--and others. Soil Conservation Series of filmstrips--Television shorts--radio tapes--cartoon-style features suitable for reproduction in newspapers, magazines, etc.

Consumers Union of United States, Inc., Mount Vernon, N.Y.: Consumer Reports, the monthly publication of Consumers Union, 50¢ per copy, 10¢ per copy for 15 or more ordered by teacher for use in school; copy free to teacher with order. Free copy available on request.

Continental-Diamond Fibre Corporation, Dept. SCA, Newark, Del.: Free booklet: Dilecto, Celoron (laminated and molded thermosetting plastics)--Diamond Vulcanized Fibre--Mica--and General Catalog.

Cooperative Recreation Service, Inc., Radnor Rd., Delaware, Ohio. Free Leaflets: For students who enjoy games based on mathematics send for Ancient Counting Games of South India--Adi and Wari, A Count and Capture Game--O'Land, the Mansion Games from Viet Nam.

Coors Porcelain Co., Golden, Color,: Free Booklet: The Evolution of a Lump o' Clay, explains steps in process of manufacture of chemical, scientific and industrial porcelain.

Corn Industries Research Foundation, Inc., 3 E. 45th St., New York 17, N.Y.: Free: List of publications. Included are such items as: Our Gift from the Indians (44 pages)--Corn in Industry (61 pages).

Corning Glass Works. Corning, New York: Free Booklet: Laboratory Glass Blowing with Pyrex (to sponsors only) if requested on school stationery.

Cornoet Instructional Films, Sales Dept., 65 E. South Water St., Chicago 1, Ill.: Film Catalog of 16mm sound motion pictures, including more than 150 science subjects with details of preview, purchase and rental. (A Teacher's Guide available for each film). Free listing of more than 150 16mm sound motion pictures in science for all grade levels.

Covington Lapidary Engineering Corp., 1st St., and Highway 99, Redlands, S. Calif.,: Free information on gem cutting. Free 16-page Lapidary Equipment and Supply Catalog, showing the most complete line in America.

Thomas Y. Crowell Co., 432 Fourth Ave., New York 16, N.Y.: Teachers' Guide to the Elementary Science Experiment Books by Nelson F. Beeler and Franklyn M. Branley.

Free: Complete experiments with easy-to-obtain materials and simple instructions in such fields as atomics, electricity, chemistry, light, optical illusion, microscope, airplane instruments. Books on Science for all Age Groups. Free: Descriptions of a variety of science books for different age groups and on different subjects. Books for the International Geophysical Year. Free: Descriptions of books particularly suitable during the activities of the International Geophysical Year.

Danish Information Office, 588 Fifth Ave., New York 36, N.Y.: Free: two illustrated pamphlets, Danes of Today and Denmark Today and a Bulletin, Greenland Today. Those interested in aviation may send for a free copy of the Ellehammer Number of Danish Foreign Office Journal. For travel literature address Danish National Travel Office, same address.

Defenders of Furbearers, DOF, 3310 Dent Place, N.W., Washington 7, D.C.: Junior Membership: Dues for school year 25¢ includes pencil--pin prizes--2 stories--4 issues of Junior News. Adult Membership: $2.00, Active Membership, Four News Bulletins a year and free releases. Films: 16mm-rental $2.50--$5.00.

Delta Air Lines, Inc., Atlanta Airport, Atlanta, Ga.,: Free: General Airline materials of educational value. Free Booklet: A visit to Delta Headquarters.

Denoyer-Geppert Co., 5235 Ravenswood Ave., Chicago 50, Ill.,: Student's Edition of the Classification of Animals Chart 17" x 22", 35¢.

Denver Museum of Natural History, Pub. Dept., City Park, Denver 6, Colo.,: Free: Price list of our own and recommended natural history publications.

Diabetes Association of the District of Columbia, Inc., 1801 Eye St., N.W. Washington 6, D. C. Free: Booklets on the cause, prevention and care of Diabetes. More specific information available on phone or written request.

Eugene Dietzen Co., 218 E. 23rd St., New York 10, N.Y.: Free Booklets: Drawing Instruments and Tools--Use and Care of Drawing Instrument with Instructive Exercises.

The Joseph Dixon Crucible Company, Jersey City 3, N.J.: Free: Graphite: A Mineral Which has Many Uses--paper on the characteristics and uses of graphite.

Doerr Glass Company, Vineland, N.J.: Free: Facts aboutthe Economics of Laboratory Glassware, a 16-page, 2-color pamphlet which describes the essential differences between lime glass and heat-resistant borosilicate glassware. Covers physical, thermal and chemical properties of each. Free information will also be furnished on laboratory glassware for use in school and college laboratories.

The Donley Brothers Co., 13915 Miles Ave., Cleveland 5, Ohio.: Book of Successful Fireplaces and How to Build Them (76 pp., well illustrated, 16th Ed.) trouble-free masonry fireplaces, heat circulating type; outdoor fireplaces; cures for faulty fireplaces, 75¢--Outdoor Fireplaces, How to Build Them, all types, 50¢.

Dover Publications, Inc., 920 Broadway, New York 10, N.Y.: Free: circulars, catalogs and announcements of Dover publications. Approximately 200 paperbound books ranging in price from 60¢ to $2.00., including mathematics, physics, engineering, history of sciences, biological sciences and every other aspect of science. Level of content ranges from very elementary to very advanced.

Duke University, Department of Botany, Durham, N.C.: Free: Illustrated poster on careers in botany. Available to teachers, science club advisors and educators.

Duodecimal Society of America, Inc., 20 Carlton Place, Staten Island 4, N.Y., Free, single copies on individual requests: Folder, the Duodecimal Society of America, information on duodecimals and the purposes of the Society. Pamphlet, An Excursion in Numbers, by F. Emerson Andrews, on duodecimals, and the use of the twelve base in general. (Bulk orders 10¢ a copy.) Magazine: The Duodecimal Bulletin, official organ. Ised abouttwice yearly.

E. I. du Pont de Nemours and Co., Wilmington, Del: Free: single copies to teachers and club sponsors only. From Publication Department, SCA: Booklets: This Du Pont--The Story of Business: Large and Small--The Story of Creative Capital--The Story of Life in a Large Corporation--Protecting the Public Health. Bulletins: Ammonia--Camphor--Cellophane--Coal's Chemical Uses--Neoprene--Nylon--Nylon Plastic--Silicon. From Advertising Department, SCA: Booklets: A Cavalcade of Chemistry--Chemistry and the Farmer--Caol Tar and the Chemist--Salt and the Chemist--The Story of Cellulose--The Story of Coal, Air and Water.

Eastman Kodak Company, 343 State St., Rochester 4, N.Y.: Free Catalog: Kodak School and Club Services. Motion picture films and slides on photography for group meetings. Presentation materials such as 16mm soundmotion picture films, slide-tape talks, and slide talks with print manuscript loaned free of charge. Writ e direct to Audio Visual Service at above address for catalog.

The Eaton-Dikeman Co., Dept. SCA, Mount Holly Springs, Pa.: Free: Literature on Laboratory filter papers and papers for chromatography and electrophoresis.

Thomas Alva Edison Foundation, Inc., 8 W. 40th St., New York 18, N.Y.: Free Booklets of science experiments, other materials. List of publications is available.

Edmund Scientific Co., 505 E. Gloucester Pike, Barrington, N.J.: Free catalog of commercial and war surplus lenses, prisms, filters, mirrors, solar energy items, satellite telescope, instruments, etc. Priced especially for the amateur experimenter, hobbyist and gadgeteer. Lists imported microscopes, telescopes, spectroscopes, and other items, both popular and unusual. Also complete line of astronomical telescopes and all parts for making your own. Manufactures and sells line of lowcost science teaching aids. Also parts to make your own hand stroboscope, inexpensive diffraction grating replica film, coiled spring wave demonstrator, ripple tank, motorized stroboscope and others. Booklets on How to Make Projectors, Photographic Enlargers, Telescopes, Magnifiers, Riflescopes, Spectroscopes, Projecting and Condensing light, Infra-Red Units, Star Chart, etc., From 10¢ to $1.00.

Educational Services, 1730 Eye St., N.W., Washington 6, D. C.: Free: Leaflets describing 18th edition of Educators Guide to Free Films and Educators Guide to Free Slidefilms. Free to Teachers and Librarians: Reprint of Article, Towards Better Schools, by Dr. John Guy Fowlkes.

The Electric Storage Battery Co., P.O. Box 8109, Phila. 1, Pa.,: Free booklets: The Storage Battery; Its Fundamentals, Use and Maintenance--Facts and Fallacies about Weather. Free charts: Parts andAssembly of a Lead-Type

Storage Battery--Exice Batteries and the Service for which they are Used
Diagram of a Pennsylvania Coal Mine.

Electro Metallurgical Company, Union Carbide Corporation, 30 E. 42nd St., New York 17, N.Y.: Free (Limit of 5): Booklets, Hot Metal Magic--Outlo for Titanium.

Empire State Observatories, 350 Fifth Ave., New York, N.Y.: Free Leafle Facts and Figures about the World's Tallest Structure

Employers Mutuals, 407 Grant St. Wausau, Wisc.,: Free Safety Literature. Free list of safety educational films available.

Encylcopaedia Britannica Films, 1142 Wilmette Ave., Dept. SCA, Wilmette, Ill.,: Free Catalogs: 16mm sound educational films and 35mm filmstrips on science. Also rental films--features and short subjects from major Hollywood producers--includes such titles as The Story of Alexander Grah Bell; the Story of Dr. Ehrlich's Magic Bullet: Edison, the Man; The Sto of Louis Pasteur: Madame Curie, etc.

Engineers Council for Professional Development, 29-33 West 39th St., New York 18, N.Y.: Folder, After High School--What? Discusses careers in Engineering and Science. Single copy free--Additional copies at 3¢ or 3 for $1. Booklet: Engineering--A creative Profession, Guide for high school students, 25¢. Pamphlet: Curricula leading to First Degrees in Engineering, 25¢. Pamphlets: Accredited Curricula Technical Institute Programs, 25¢. Do I Have Engineering Aptitude, lot of 50 for $2.00.

Entomological Society of America, 1530 P St., N.W., Washington 5, D.C.: Brochure: #1, 12 pages. Opportunities in Professional Entomology, one copy 25; 25 copies--$5.00.

Esso Research and Engineering Co., Public Relations, P.O. Box 45, SCA, Linden, N.J. Free Booklets: Ideas in Action--101 Atomic Terms--Radioactivity--Keys to Progress.

Fairbanks, Morse and Co., Public 600 S. Michigan Ave., Chicago 5, Ill.: Booklet: Catechism of Electrical Machinery, 25¢ to SCA Clubs.

Farm Film Foundation, 1731 Eye St., N.W., Washington 6, D.C.: Free list 16mm sound motion pictures available on farm and other subjects.

Field Enterprise Educational Corporation: Merchandise Mart Plaza, Chica 54, Ill., Reprints from World Book Encyclopedia: Horse--Earth and stars Space Travel, Guided Missile. Reprint from Childcraft: Trees and How they Grow. Single copies free; quantity rates quoted on request. Free; index of Unit Teaching Plans. This lists items such as: Insects--Trees Weather--etc.

Firestone Steel Products Company, Akron 1, Ohio: Free: Booklet, A Prog Report to Industry; How Research and Testing are Translated into Better Products.

Frank H. Fleer Corp., 10th and Somerville St., Philadelphia 41, Pa.: Free film--Fun for a Penny.

Fleisher Yarns, Inc., 30-20 Thomson Ave., Long Island City, N.Y.: Free Bulletin: From the Sheep to the Needle.

The Florida Academy of Science, Fr. A.G. Smith, Department of Physics, University of Florida, Gainesville, Fla. Journal: The Florida Academy of Science, $1.25 per Number (Quarterly)

Luther Ford and Co., 100 N. 7th St., Minneapolis 3, Minn.: Free direction slips: For making mysterious M.S.B. Flowers (salt crystal growing).

Ford Motor Company, Educational Relations Dept., The American Road, Dearborn, Mich.: Free pamphlets: Facts and Facets of the Automotive Industry. Additional material on the Ford Motor Co., past and present will be sent to interested school or general libraries for circulation. Free catalog of Motion Pictures.

The R. T. French Co., 1 Mustard St., Rochester 9, N.Y.: Booklets: Manual of Spices and Herbs, 10¢--Your Canary, 25¢.

Frigidaire Division, General Motors Corp., Dayton 1, Ohio: Free literature, films, etc. Contact your local Frigidaire dealer for complete details and arrangements for procuring.

Gaines Dog Research Center, 250 Park Ave., New York 17, N.Y.: Free: illustrated journal on problems of interest to dogbreeders, such as genetics, disease control, nutrition. Leaflet listing other literature and films on dogs. Films on free loan, borrower pays express charges. Those available include: Second Sight, on training dogs to lead the blind--Friend of a Friend, on the work of the veterinarian--Most Happy Dog, featuring the late Rear Admiral Richard E. Byrd, and his dog, scenes from 1926 Byrd Antarctic Expedition.

General Electric Company, Publications for schools. One River Road, Schenectady 5, N.Y.: Free to teachers only: Single copies or classroom sets, grades 7-12, science, mathematics and social studies booklets--Four Why's--Three Why's--What Do You Think About?--Start Planning Now for Your Career--Story of the Turbine--Man-Made Magic--Electricity Around Us--Network of Power--Adventures in Jet Power--Inside the Atom--Land of Plenty--Math at General Electric.

General Motors Corp., Educational Relations Section, P.O. Box 177, North End Station, Detroit 2, Mich.: Free booklets: How the Wheels Revolve--We Drivers--Transportation Progress--Metallurgy and Wheels--Electricity and Wheels--ABC's of Hand Tools--Optics and Wheels--Diesel, The Modern Power--A Power Primer--American Battle for Abundance--Story of General Motors--A Look at GM--A to Zero or Refrigeration--Precision, A Measure of Progress--Can I Be a Scientist or Engineer? The Story of Power. Free: List of films available for loan at no charge.

The Glacier Natural History Association, Inc., West Glacier, Mont: Free: list of publications sold in Glacier National Park, For Sale: Motorists Guide to the Going-to-the Sun Highway, 25¢; Glaciers and Glaciation in Glacier National Park, 25¢; Geological Story of Glacier National Park, 25¢; Trees and Forests of Glacier National Park, 50¢; 101 Wildflowers of Glacier National Park, 50¢; Topographic Map of Glacier National Park, 50¢. Add 10¢ postage to above. Mammals of Glacier, $1.00. Guide to Glacier National Park, $1.50. Add 15¢ postage to above. Self-guiding Nature Walks; Trail of the Cedars, 10¢; Trick Falls, 10¢; Swiftcurrent Lake, 10¢. Add 5¢ postage to the above.

Glass Crafts of America, 522 Fifth Ave., New York 36, N.Y.: Free Bulletin: History of Glass.

The B. F. Goodrich Co., Pub. Rel. Dept., Akron, Ohio: Free booklets (cartoon style): Wonder Book of Rubber, Teacher's Manual Available--Tommy gets the Keys, guide to highway safety for teenagers.

Criegers' Inc., A20, 1633 E. Walnut St., Pasadena 4, Calif.: Free: Literature on how to get 300-page Reference Encylcopedia and Catalog of ideas and listing of over 3,000 items for everyone interested in Gems and Jewelry Making.

Hagon Chemicals and Controls, Inc.: P.O. Box 1346, Pittsburgh 30, Pa.: Free: Products and Services Booklet with information about meters, pressure controls, power postioners, flow signal transmitters, control valves and electronic devices. Description of plant-wide water consulting service.

Hammermill Paper Co., 1567 E. Lake R., Erie 6, Pa.: Films: The Gift of TS'ai Lun: Paper. Film tells in comprehensive, pictorial story how writing papers are made from spruce logs. Borrowers pay transportation costs-- Great White Trackway, a photogenic story of the pulp and papermaking process, 28 minutes. Free Pamphlets: From Forest Tree to Writing Paper. Single copies, free. 2¢ each in quantities. Packet Project: How to Make Paper by Hand as it has been made for 2,000 years. Included is a little book giving full instructions for the making of a sheet of paper by hand; draftman's sketch showing how to make mold and decay; piece of Fourdrinier wire; sheets of ledger paper to help in process. (Only common kitchen utensils required.) 25¢ for individual copies; $1.50 for lots of ten.

The Handcrafters, Waupun, Wis.: Free: information on materials and methods of craft work. Booklets (53¢ each): Metal Modeling Manual--Knots and Braids in Handicraft--Modernistic Felt Handicraft--Sketchbook, (sketches for tracing.)

Health Careers, National Health Council, 1790 Broadway, New York 19, N.Y.: Free Publications: Health Careers Guidebook, 155-page book for guidance counselors, science teachers, and other high school teachers--Partners for Health for high school students. Film: Health Careers, $2.00 for one week's use; also available locally, often without charge--address local inquiries to State Dept. of Ed. or Dept. of Health.

Hershey Chocolate Corp., Hershey, Pa.,: Free Booklet: The Story of Chocolate and Cocoa.

John Woodman Higgins Armory, Inc., 100 Barber Ave., Worcester 6, Mass.: Free: Educational programs on armor through the ages and its relation to art, history and the manufacture of modern steel products. Free leaflets: The Steel Museum--Early Iron Age Craftsmanship.

Higgins Ink Co., 271 Ninth St., Brooklyn 15, N.Y.: Booklets: Techniques, the best methods of ink sketching, $1.50. Technical Illustration, $2.50--Color Digest, $2.00--Lettering, the history of calligraphy, script alphabets and illuminating, $1.50--Higgins Arts and Crafts Projects, 10 illustrated, $1.50--The All-American Art Cartooning, $1.50. Free: Ink Sketching--Higgins Memorial Awards, information on how to enter Drawing Ink contents of the National Scholastic Awards--Biography of Charles M. Higgins--Hand-made Color Card of Drawing Inks--History of Ink--Catalog Folder.

Holtzer-Cabot Motor Division, National Pneumatic Co., 125 Armory St., Boston 19, Mass: Free to science clubs: 8-page booklet, 3 experiments in Motor Theory and Application with the Holtzer-Cabot Systems Development Motor Kit. Bulletin gives experiments in detail with diagrammatical drawings. Includes series of questions to be answered by experiments, shows how to plot speed torque curves, etc. Fractional Holtzer-Cabot Motor catalogs available describing motors, their uses and input-output requirements.

Home Manufacturers Assn., Suite 1117 Barr Bldg., 910-17th St., N.W., Washington 6, D.C.: Free: list of firms building prefabricated structures. Housing Annual--170 pages reference manual on manufactured factory built homes, with 50 pages of floor plans and elevations. Cost $1 postpaid. PF--The Magazine of Prefabrication----monthly pub. $3.00 year.

Household Finance Corp., SCA, Prudential Plaza, Chicago 1, Ill.,: Free: Money Management Program folder, describes booklets and filmstrips on money management, consumer credit.

Humble Oil and Refining Co., Publications Section, P.O. Box 2180, Houston 1, Texas: Free booklets: Texas Through 250,000,000 Years--Twice-Told Tales of Texas--A Visit to Baytown--The Story of Humble Pipe Line Co.

C. Howard Hunt Pen Co., 7th and State Sts., Camden 1, N.J.: Free: 6 large Speedball Lettering Instruction Charts. 8 Instruction Charts on Linoleum Block Printing. 4 plates on Large "Flash Card" Lettering.

Illinois State Museum, Springfield, Ill.,: Free: List of Publications giving titles and prices (ranging from 25¢ to $10.00; some free) of publications on the natural history of Ill.

Industrial Forestry Assn., 1410 S.W., Morrison St., Portland 5, Oreg.,: Free Booklets: Forest Resources of the Pacific Northwest and Their Use--West Coast Tree Farms, Growing Trees for You.

Inland Steel Co., 30 W. Monroe St., Chicago 3, Ill.,: Free: How Steel is Made. Steel making flow chart and plant map in color folder: Inland Makes Steel.

Institute of Laboratory Animal Resources, National Academy of Sciences, National Research Council, 2101 Constitution Ave., N.W., Washington 25, D.C.: For restricted distribution, single free copies to teachers and club sponsors: Quarterly Bulletin, Information on Laboratory Animals for Research.

Institute of Visual Training, 40 E. 49th St., New York 17, N.Y.: Free Pamphlet: Films designed to help you teach.

Insulation Board Institute, 111 W. Washington St., Chicago 2, Ill.,: Free Booklets: Fundamentals of Building Insulation--Sound Insulation Values of Floors and Walls--How to Use Insulation Board. Free Leaflet: Lists motion pictures available free on phases of insulation.

International Acetylene Assn., 205 E. 42nd St., New York 17, N.Y.; Free Bulletin: Lists various publications on oxy-acetylene cutting, welding, hard-facing, flame-hardening, etc. Priced 35¢ to 50¢. Complete set of 10 for $3.50. Discount for quantities.

International Film Bureau, Inc., 57 E. Jackson Blvd., Chicago 4, Ill.,: Free list of rental films such as: Challenge, Science Against Cancer--Biology Series--By Map and Compass (color)--Living Science Series (birds and animals, color). Also Science LP Records. Ask for "List S."

International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.: Free booklets: The Why and Wherefore of the Diesel Engine--Let's Practice Soil Conservation for a Permanent Agriculture--Land of Plenty--The Story of Twine in Agriculture--McCormick Reaper Centennial Source Material--Cyrus Hall McCormick, Father of Farm Mechanization--Blueprint for Opportunity Unlimited--The Watershed Program--Historical Facts About Early International Harvester Vehicles (Motor Trucks)--More Productive Gardening--Your Farm Equipment.

Interstate Oil Compact Commission, P.O. Box 3127, Oklahoma City 5, Okla.: Free information will be furnished on oil conservation. Free information will also be furnished on oil conservation laws. Newsletter: Compact Comments, free (monthly) Bulletin: Interstate Oil Compact Commission Bulletin, free. Film: "Oil for Tomorrow", 30 min., 16mm sound, free, in color.

The Izaak Walton League of America, 1326 Waukegan Rd., Glenview, Ill.; Free: single copies of selected materials available to teachers on conservation of soil, woods, waters and wildlife.

The Sam Handy Organization, 2821 E. Grand Blvd., Detroit 11, Mich.: Free: catalog and literature describing filmstrips on astronomy; earth science/ water life; bird study; physics; health; weather; heat; light and sound; and general nature study for primary grades through high school.

Johnson's Wax, Dept., SCA-58, Racine, Wis.: Free Booklets: How to Take

Care of Furniture--How to Make House Cleaning Easiest--How to Take Care of Floors. Free Leaflet: What You Should Know About Insecticides--What You Should Know About Insect Repellants--What You Should Know About Air Deodorants--Three Easy Recipes for Finishing Furniture--Home Safety Check List--Floors in the Home (Safety Tips.)

Junior Engineering Technical Society (Jets, Inc.,) Box 589, East Lansing, Mich: Program dedicated to the advancement of engineering and science. The Society offers experience and assistance in scientific endeavors to high school students interested in careers in the science and engineering fields. Educational aids are provided to help students discover their potential abilities and the opportunities existing in these areas. Free materials include an organization kit, film index, chapter charter, membership pin, weekly mailings with newsletter of industrial and professional publications pertaining to engineering and science, and information on projects and research. In addition, the organization sponsors project and essay contests. JETS chapters are sponsored by industry and/or professional groups in 35 states and two foreign countries. For additional information, write to the above address.

Kaiser Aluminum and Chemical Corp., 1924 Broadway, Oakland 12, Calif.: Attn: Public Rel., Dept. Free information is furnished on the processing steps required for the production of aluminum, and on the processes and products of the company's Chemicals Division. Two 16mm sound and color films--one on the history of the company and the second on aluminum production processes--are also available, subject to payment of return postage.

The Kalart Co., Inc., SCA-2, Plainville, Conn.: Free Booklet: Editing for Better Movies, an easy-to-read, fully illustrated book that tells in non-technical language what every movie-maker needs to know about film editing, splicing, story-telling, sequence development; how to get humor, action, professional results. 10¢ handling charge.

Kellogg Co., Home Economics Services, Battle Creek, Mich.: Free Booklets: Day to Day Good Health Record--Choose Your Calories Wisely--Foods for Growing Boys and Girls--The Grains are Great Foods (one copy to sponsor only)--A Good Breakfast for Good Health.

Keystone View Co., Meadville, Pennsylvania: Leaflet: How To Make Handmade Lantern Slides, 5¢.

LaMotte Chemical Products Co., Chestertown, Md.: Free Booklets: The ABC of ph control--La Motte Blood Chemistry Handbook--Facts About Soil Testing on Your Farm. LaMotte Soil Handbook, 25¢ per copy. Composition of soils; nutrient elements in soils and their properties; importance of proper liming of soils; soil preferences of many plants and shrubs; how to take samples of the soil and test it for better plant growth. Free booklets are restricted to modest quantities only, and to responsible distribution.

Lead Industries Assn., Dept. SCA, 60 E. 42nd St., New York 17, N.Y.: Free booklets and reprints such as: Lead Welding--The Story of Lead (in two parts)--Primary Lead Production Areas in the U.S.--Lead in Chemical Installations--White Lead Paints--Metal Protective Lead Paints--Lead Oxides (litharge)--Other Industrial Lead Compounds. Books: Lead in Modern Industry, $1.00--Lead Work for Modern Plumbing: $1.50.

R. G. LeTourneau, Inc., 2399 S. MacArthur, Longview, Texas: Free: two and three-color brochures on LeTourneau electrically powered and controlled equipment (all wheeled vehicles are driven by the LeTourneau Electric Wheel). Order brochures by NO's or titles shown in parenthesis as follows: logging (No. 990-10-7), offshore oil drilling platforms (No. 990-10-7), offshore oil drilling platforms (No. 501-51), off-road transportation (Off Road Transportation Brochure), land clearing (Roots Out or Cuts Flush). and materials handling (No. 850-10-7).

Libbey-Owens-Ford Glass Co., Public Relations Dept., 608 Madison Ave., Toledo 3, Ohio.: Free Pamphlets: Glass for Product and Engineering Design--Aladdin Was An Amateur.

Libby, McNeil and Libby, 200 S. Michigan, Chicago 4, Ill.: Free Booklet: Today's Canned Foods. Free Leaflets: The Story of Tomato Juice--The Story of Hawaiian Pineaplle--The Story of Canned Vegetables--The Story of Canned Juices.

Linde Company, Union Carbide Corp., 30 E. 42nd St., New York 17, N.Y.: Free booklets: The Amazing Story of Measurement--Micrometer Reading Made Easy. (Both cartoon style).

The MacMillan Company, 60 Fifth Ave., New York 11, N.Y.: Attn: Tech. Book Dept., SCA, Free Descriptive literature and circulars discussing such books as Amateur Astronomer's Handbook--Satellites and Spaceflight--One Round the Sun, the Story of the International Geophysical Year, and many more. Any of the publications listed in the circulars may be ordered on a ten-day free examination basis.

Magnaflux Corp., 7300 W. Lawrence Ave., Chicago 31, Ill.: Free (3 per class only): Booklets, article reprints, and circulars on Non-destructive Testing: The use of numerous scientific methods and phenomena to show and find cracks in parts or assemblies during manufacture or overhaul. Indicate any specific area of interest as aircraft, truck, industrial, oil, tools, etc.

The Malayan Tin Bureau, 1028 Connecticut Ave., N.W., Washington 6, D.C.: Free information is available on the production of tin ore andtin metal in the Federation of Malaya. Free Booklets are available on the uses of Straits in the United States industry. Also available is a monthly newsletter, Tin News, devoted to markets, prices, and uses of tin.

Mandeville and King Co., 1255 University Ave., Rochester 1, N.Y.: Flower gardening: Series of eight pamphlets bound in one booklet, 50¢. Pamphlets may be purchased singly at 10¢ each. Titles include: Planning a Flower Garden--Rock Gardening--A Children's Garden--The Culture of Perennials, etc.

Manufacturing Chemists' Association, Inc., 1625 Eye St., N.W., Washington 6, D.C.: (Aid-to-Science Education Program is executed on behalf of the chemical industry.) Free to each club: 1 teacher information sheet, 30 student guides for each of 31 open-ended chemistry experiments. (for senior high school level.) Free to each club: (for junior high school level): 1 each: Superstition to Supersonics, (Teacher edition of experiment book), teaching charts--What Science Means to You and Big Questions of Science; 35 copies: Superstitition to Supersonics (Student Edition of Experiment Book); Vocational Guidance booklet, Frontiersman of the Future. Additional copies of all above publications available at special prices. For further information on entire MCA Education program, request free copy: An Industry Helps Our Schools.

Maryland Academy of Sciences, Enoch Pratt Free Library Bldg., Baltimore 1, Md.: Graphic Time Table of the Heavens and Condensed Almanac Print.

Masonite Corporation, 111 W. Washington St., Chicago 2, Ill.: Free Booklet: Behind the Scenes with Masonite, shows how a manufacturer of hardboard handles forestry operation on a tree-farming basis, and shows how trees are converted to hardwood.

The Mathematical Association of America, c/o University of Buffalo, Buffalo 14, N.Y.: Booklets: Professional Opportunities in Mathematics, 25¢ or five for $1.00.

Melville Shoe Corp., 25 W. 42nd St., New York 36, N.Y.: Free Film (loaned for shipping charges only): If the Shoe Fits, shows whole process of shoe manufacture--The Danger Line, discusses foot health and proper shoe-fitting for young feet. Booking arrangements must be made with Institute of Visual Training, 40 E. 49th St., New York, N.Y.

Merck Sharp and Dohme, Philadelphia 1, Pennsylvania: Free: Technical material on such medical products as Vitamins, Steroids, Hormones, Antibiotics, Biologicals and prospects for vaccines against virus-caused diseases. Information on patterns of distribution on the pharmaceutical industry.

Milk Industry Foundation, 1145 19th St., N.W., Washington 6, D.C.: Free booklet: Milk Facts.

Minerals Unlimited, 1724 University Ave., SCA, Berkeley 3, Calif.: Free: list of minerals, collector's supplies. Small specimens from 10¢ up.

Modern Laboratory Equipment, 1811 Santa Monica Blvd., Los Angeles 25, Calif.: Dept. P. Booklet: Photography of Heart Valves with the Moody Cardiac Pulse Duplicator. 10¢ each. Research: Biological Photography with the Moody Supplemental Lens., 5¢ each. Free: Full-color-8-page catalog of science film subjects (to club sponsors only).

Muellers, 1002 E. Camelback, Phoenix, Ariz.: Free: Catalog and lists of mineral specimens and inexpensive, polished gemstones.

Museum of Science and Industry, Jackson Park, Chicago 37, Ill.: Free: List of Scientific Pamphlets and Books.

The Narda Ultrasonics Corporation, SCA, 625 Main St., Westbury, L.I., N.Y.: Free: Data sheets on the application of ultrasonics to industry. Applications include cleaning, plating, deburring, drilling, metal pickling, polishing, chemical milling, and others. Vase history reports also available on numerous applications. Also copies of speeches and articles of broader scope on the significance of ultrasonics as a new and rapidly growing field of industry.

The National Association for Mental Health, 10 Columbus Circle, New York 19, N.Y.: Free: Two pamphlets--list of Mental Health Publications and Audio-Visual Aids--Catalog of Selected Films for Mental Health Education; and one announcement describing Plays for Mental Health Education. Also inexpensive leaflets (ranging in price from 70¢ per hundred to $3.25 per hundred) on many different phases of mental health and mental illness. A new short play, "Which Way Out?" has been written to help young people understand something about emotional illness. With its accompanying discussion guide, the play is designed primarily for production (under adult guidance) by classroom and club groups. Producing packet: $3.50; single copy script and discussion guide for review: 75¢.

National Association of Food Chains, 1025 Connecticut Ave., N.W., Washington 6, D.C.: Free Booklet: Looking for a Career? Film: TheSpud and You.

National Association of Manufacturers, Education Dept., 2 E. 48th St., New York 17, N.Y.: Booklets (Free to Schools for Classroom use): Your Future is What You Make It--Your Opportunities in Management--Your Opportunities in Science and Engineering--Your Career in Teaching--Your Opportunity in Industry as a Technician--Your First Job.

National Association Practical Refrigerating Engineers, 432 N. Waller Ave., Chicago 44, Ill.: Free: Current information on industrial refrigeration and industrial air-conditioning applications; reprints from monthly and annual publications available. Industrial Refrigeration magazines, NAPRE official organ, published monthly, $2.00 yearly.

National Audubon Society, 1130 Fifth Ave., New York 28, N.Y.: Free: Guides to the Out-of-Doors folder lists 55 Audubon Nature Bulletins, inexpensive teaching aids for teachers of natural science, and for students. 15¢ each. Subjects such as, Live Insects in the Classroom--Rock Stories and How to Read Them--Forecasting theWeather--How a Thunderstorm Grows--Mysteries of Bird Migration--Life in a Pond. Free: Folder listing 12 Audubon Nature Charts, 25¢ each, subjects: Seeds, Leaves, Salt Water and Forest Chains, Twigs, Evergreens and others. Free: information on how to form an Audubon Junior Club.

National Aviation Education Council, SCA, 1025 Connecticut Ave., N.W., Washington 6, D. C.: Free: Subscription to Skylights (aviation facts, news stories, history, careers, etc.). Published 9 times a year. Pictures and booklets on airplanes, missile, etc. Books: U.S. Aviation Today--1958. 126 pages of photographs, descriptions, and performance ratings of all U.S.

aircraft currently manufactured, including 30 pages of rockets and missiles in production, including how jets are built, how they operate and jet records--50¢. Space Frontier, 24 pages, space facts and space exploration with bright charts and photographs--25¢. A Day in the Life of a Jet Test Pilot, 24 pages, what a test pilot does in his daily work, illustrated--50¢. Aircraft Number 116, the story of an aircraft plant and how planes are built, illustrated 50¢. Helicopters operate and how they work for us, illustrated--50¢.

National Biscuit Co., 425 Park Ave., New York 22, N.Y.: Free leaflets: The Nabsico Vanilla Wafer and How it Grew--The Story of Ritz Crackers--Wheat, the King of Grains-What the Nabisco Seal Stands for and how it started. For best service mention your grade level when requesting materials.

National Board of Fire Underwriters, 85 John St., New York 38, New York: Free: A list of wide variety of bulletins, booklets, posters, questionnaires and stickers on fire prevention such as: Your Farm and Fire Safety--Farm Inspection Bland--Home Inspection Bland--Your Fire Safe Home--The Careless Family--Fire Safety Suggestions for Parents Who Employ Baby Sitters. All are free in single copies or small quantities. Mention theage group that will be using the material when writing so suitable material can be sent.

National Broadcasting Company, Dept. of Information 30 Rockefeller Plaza, New York 20, N.Y.: Free: Information on Opportunities for Women in Radio and Television--Announcers Qualifications--Job Opportunities in Radio with the National Broadcasting Co.--Job Opportunities in Television--Bibliography on Occupations in Radio and Television.

National Carbon Co., Div. of Union Carbide Corp., 30 E. 42nd St., N.Y. 20, N.Y.: Free Booklet: The Inside Story of Dry Batteries.

National Coal Association, Educational Dept., Southern Bldg., Washington 5, D.C.: Free Booklets: Genie Story--Glass Report--Bituminous Coal Story--Coal (World Book Ency. Reprint). Free Charts: Cutaway View of an Underground Coal Mine--Map of Coal Areas in the U.S.A. A Miracle of Modern Chemistry. Free to Teachers: The Beginnings of Coal--List of Free Teaching Aids. Information on Films and Filmstrips.

National Council of Teachers of Mathematics, 1201 Sixteenth St., N.W., Washington 6, D.C.: Mathematics Clubs in High Schools, by Walter M. Carnahan, discusses objectives, organization, officers, constitution, activities programs, with report of tried practices. Bibliographies and list of active clubs. 33 pp. 75¢. each.

National Dairy Council, P.S. Dept., SCA, 111 N. Canal St., Chicago 6, Ill.: Free Catalog of Health Education Materials. Lists and describes folders, booklets, poster, charts, and other visual aids. Prices vary; most of them inexpensive.

National Fire Protection Assn., Dept. PR, 50 Batterymarch St., Boston 10, Mass: Free: The Story of the National Fire Protection Association which lists all services of the organization and offers a variety of publications

list: Story of Sparky's Fire Department. Folders (5¢ each): Facts About Fire: Home Fire Safety Check List; Your Family and Fire; When Fire Strikes You; Your Clothing can Burn: Fire Safe Home.
Comic Books (5¢ each): Sparky Fire Books--Early Man and Fire--Man Learns More About Fire. Sparky's Fire Department Membership Kit, 25¢ each.

National Fluid Power Assn., 1618 Orrington Ave., Evanston, Ill: How Fluid Power Serves Industry and You, 10¢--A Glossary of Terms for Fluid Power, 20¢--Design Operation and Maintenance of Hydraulic Equipment for use with Fire Resistant Fluids, 30¢.

National Foot Health Council, SCA, Rockland, Mass.: Send self-addressed, stamped, legal size envelope for: Free posters: How Are Your Feet? Ten Basic Rules for Foot Health--Protect Growing Feet--Exercises for Foot Health--Your Feet Grow for 20 Years--Walk and Be Healthy--Prevent Foot Infections--Outgrown Shoes and Hosiery Cause Foot Troubles. Free reprints: On Foot Care and Health--Keep Your Feet Fit for the Job--Care of Children's Feet--Foot Care for the Diabetic--Diseases that Show Symptoms in the Feet.

National Geographic Society, School Service Division, 1146 16th St., N.W., Washington 6, D.C.: Weekly Bulletins, $2.00 per school year in U.S.: $2.25 per school year in Canada; Separate Color Sheets from National Geographic Magazine, 50¢ for 48. Map of the Heavens, $1.00 on paper, $2.00 on fabric. Satellite Finder Kit, $2.00. Free Educational Aids Envelope: Contains lists, samples, and prices of National Geographic books, maps, reprints, and other educational and scientific materials avail.

National Institute of Drycleaning, 909 Burlington Ave., Silver Spring, Md.: Pamphlets (10¢ each): A Great Discovery Results from an Accident--Preserving Fashion is Our Business.

National League for Nursing, Committee on Careers, 2 Park Ave., New York 16, N.Y.: Booklets (single copies free): List of Professional Schools of Nursing in the United States--List of Schools of Practical Nursing--Nursing Has a Future for You--The College Way to a Nursing Career--Team Mates--Men Working for a Career in Nursing. Booklets: Careers in Nursing, A Handbook for Counselors (25¢)--Program Guide for Future Nurses Clubs (50¢)--Nurses for a Growing National (35¢).

National Live Stock and Meat Board, 407 S. Dearbom St., Chicago 5, Ill.: Free Booklets: Function of Food--Facts About Meat--Tips for Teens--Meat Builds Better Breakfasts--Meat Snacks.

National Mineral Wood Assn., 2906 Americas Bldg., Rockefeller Center, New York 20, N.Y.: Free Publications: How to Install Mineral Wool Batts and Blankets in Houses and Buildings--How to Install Mineral Wool Pneumatically--How to Insulate your Home for Electric Heating--How to Cut Air Conditioning Costs with Adequate Insulation--How to get the most Value from Your Mineral Wool Insulation.

National Parks Assn., SCA, 2000 P St., N.W., Washington 6, D.C.: Free: Favorite materials such: National Primeval Park Standards--We Need

Wilderness--reprints from National Parks Magazine. National Parks Magazine, $3.00 per year to schools,universities and public libraries. Books: Exploring oure Pre-historic Indian Ruins, $1.00--Exploring the National Parks of Canada, $1.50. Films: List of films on national parks available on rental basis.

National Safety Council, Inc., 425 N. Michigan Ave., Chicago 11, Ill.: Safety Education Data Sheets. A series of 87 subjects for teacher or student use. May be purchased separately at 10¢ each or by the set in bound volume at $3.89. Quantity prices reduced. Ten per cent discount to schools. Free: Price list and brief description of materials, publications and supplies--classified list of safety instruction cards.

National Science Teachers Assn. Future Scientists of America Fdn., 1201 16th St. N.W., Washington 6, D.C.: Tomorrow's Scientists, 8-page, illustrated science magazine for students in grades 9-11. Eight issues. Free pamphlet: Rules and Information on Eighth Annual Program of Science Achievement Awards for Students. Booklets: Encouraging Future Scientists: Keys to Careers (Free)--If you Want To Do A Science Project (50¢)--Careers in Science Teaching.(free).

The National Society for Crippled Children and Adults, Inc., The Easter Seal Society, 2023 Ogden Ave., Chicago 12, Illinois: Free: literature on crippling conditions including cerebral palsy. Bibliographies. Publications price list.

National Society for the Prevention of Blindness, 1790 Broadway, N.Y. 19,N.Y. Free: Catalog of Publications, listing wide variety of free and inexpensive publications on eye health and protection.

National Tuberculosis Assn., 1790 Broadway, New York 19, N.Y.: Booklets, pamphlets, leaflets, and posters on tuberculosis and related health problems available free from local tuberculosis associations. Films and Filmstrips on loan are also available. Requests from outside the United States should be sent to the above address.

National Wildlife Federation, 232 Carroll St., N.W., Washington 12, D.C.: Free: list of Conservation publications. Free in reasonable quantities; Folder on Wildlife Stamps albums, pictures, books, postcards. Servicing Division, SCA, materials available. Single Copy free, Miscellaneous pamphlets: Ask Me Another--This We Believe--Conservation Clubs for Juniors--A Desert in Your Own Backyard--Protecting Our Living Waters--Soil Meal Life—Water--Habitat Improvement: Key to Game Abundance--Homes for Wildlife--The Glory Trail--By Which We Live--You and Conservation--These Lands of Ours--Your Land and Mine. Let's Build series: Fish and Game Habitat construction. Send for list of Pay materials.

National Rubber Bureau, 1631 K St., N.W., Washington 6, D.C.: Free (first six copies): Map of Malaya, The Rubber Land of the World (more than 6 copies, 5¢ each). Booklet: The Story of Natural Rubber (more than 6 copies, 6¢ each)--Wall Chart of Information, Pictures, Map concerning Natural Rubber (more than 6 copies, 10¢ each).

Nature Education, SCA, Wm. G. Vinal, R.F.D., Norwell, Mass., Booklets: Games, 25¢--The Nature Guides' Dictionary, 25¢--Outdoor Schoolroom $1.00. All postpaid.

The Nestle Co., Inc., 100 Bloomingdale Rd., White Plains, N.Y.: For Spons only. Chocolate Exhibit Box, 24¢ each.

New Jersey Zinc Co., 160 Front St., New York 38, N.Y.: Free chart: Zinc the World of Things.

New York Life Insurance Company, Career Information Service, 51 Madison A New York 10, New York: Free: Career Booklets, series of 34, written by experts in their various fields. Includes, Should You Be a Chemist, Shoul You Be a Mathematician, etc. Also general booklet: The Cost of Four Yea at College.

New York Scientific Supply Co., SCA, 28 W. 30th St., New York 1, N.Y.: Illustrated Science Catalog--50¢. Nature Study Equipment, Insect Nets, Pins, Boxes, Riker Mounts, Killing Jars, Plant Presses, Spreabing Boards, Aquaria, etc.

New York State College of Agriculture, Cornell Univer., Ithaca, New York: Free: List of publications of Cornell Agricultural Experiment Station an New York State Colleges of Agriculture and Home Economics. Leaflets: Cornell Science Leaflets, 50¢ per year, 4 issues.

New York State Museum, Albany 1, New York: Free list of available museum bulletins, circulars, educational leaflets and non-technical handbooks on geology, botany, zoology and Indian lore of New York State. Prices range from free to $3.00. Indicate in your letter the field in which you are interested.

New York Zoological Society, Bronx Park, New York 60, N.Y.: Free: Separ catalogs of Technical and Popular Publications. Publications: Guide to the New York Zoological Park, $1.00--The Care of Turtles and Small Alligators, 20¢, Snakes of the New World, 50¢--The Prevention and Treatment o Snakebite, 30¢--The Story of Elephants, 10¢--North American Bears, 10¢--Gorillas, 10¢--The Kangaroos 10¢--Hummingbirds, 10¢--The Giant Panda, 10¢ Giraffe and Okapi, 10¢--The Story of Camels, 10¢--Platypus and Echnida, 15¢--Picture Sheet: Mammals of All Continents, 50¢.

Norton Co., Worcester 6, Mass.: Free Booklets: An Handbook on Abrasives and Grinding Wheels--Abrasives; Their History and Development. Film list showing available films.

Nuclear Products Co., 10173 E. Rush St., El Monte, Calif.,: Free: liter describing Staticmaster Brushes and Staticmaster Ionizing Units for use i the laboratory Information will be furnished on the neutralization of static electricity on delicate laboratory equipment.

Ohaus Scale Corporation, 1050 Commerce Ave., Union, New Jersey: Free:

catalog of Laboratory Balances and Weights for Use in Schools and by Hobbyists.

The Ohio Leather Co., 1052 N. State St., Girard, Ohio: Free Booklet: The Story of Leather: Film for Loan: The Story of Leather.

Ohio State Pharmaceutical Assn., 40 S. Third St., Columbux 15, Ohio: Free: pamphlets and brochures on pharmacy. List includes: Seniors are interested--Look to Your Future--Should Your Child be a Pharmacist?--Should You Be A Pharmacist?--I'll Take Pharmacy--Shall I Study Pharmacy? Films: Design for Living and Time for Tomorrow.

Ohmite Manufacturing Co., 3601 Howard St., Skokie, Illinois: Ohm's Law Calculator, solves any Ohn's Law Problem with one setting of the slide; simplifies and speeds up solving of many electrical problems. Reverse side includes scales for solving problems involving resistors connected in parallel and the standard slide rule A,B,C, and D scales, 25¢. Resister Color Coder, makes it easy to determine the resistance and tolerance values of EIA Color coded composition resistors. Just turn the color wheels until the color corresponds to the color band on the resistor and read the resistance value directly in ohms in the windows, 10¢.

The Okonite Co., Passaic, New Jersey: Technical publications on various subjects relating to electrical wire and cable will be sent without charge to sponsors. List of free motion picture films describing manufacture and installation of electrical wires and cables.

Oral Hygiene Publications, 1005 Liberty Ave., Pittsburgh 22, Pennsylvania: Booklet: Your Teeth and Your Life, value of periodic dental care and the dangers of neglect, illustrated by 10 two-color charts. 20 booklets for $1.00, 100 for $4.00. Folder: The Castle that Was Destroyed, fundamental facts of dentistry presented in story form for children, illustrated in fairy-tale style. 100 copies for $15.00.

Owens-Illinois, Community Relations, P.O. Box 1035-36, Toledo 1, Ohio.: Motion Picture, free-loan (to recognized science and classroom groups for limited showings; request must be made on your letterhead): Glass, Science and People (25 min., 16mm, sound color). Requests for film must be submitted at least three weeks prior to showing date.

Oyster Institute of North America, 6 Mayo Ave., Bay Ridge, Annapolis, Md.: Free Leaflet: The Story of Oysters.

Pan American World Airways, 28-18 Bridge Plaza North, Long Island City 1, N.Y.: Free: Pan American World Airways Teacher, published bi-monthly. List of free educational materials.

Parker Fittings and Hose Div., Parker-Hand Fin Corp., 17325 Euclid Ave., Cleveland 12, Ohio: Free Catalog: Tube Fabricating Equipment, Catalog 1140.

Pennsylvania Grade Crude Oil Assn., Oil City, Pennsylvania: Free Leaflet: Col. Drake's "Petrolia" Flourishes.

Pfaudler Permutit, Inc., Dept., SCA, 50 W. 44th St., New York 36, N.Y.: Free booklets: Permutit-Water Conditioning Headquarters--Why You Will Love Permutit Soft Water.

Chas. Pfizer and Co., Inc. Educational Services Dept., 800 Second Ave., New York 17, N.Y.: Free: Our Smallest Servants, a 32-page illustrated booklet on the story of fermentation chemistry and antibiotics--the Microscopic World of the Mods, a 12 x 9 inch wall chart--Your Career Opportunities in Pharmacy, a 32-page illustrated booklet.

Instruments Division, Philips Electronics, Inc., 750 S. Fulton Ave., Mount Vernon, N.Y.: Free Booklets: X-ray Analysis Theory and Instrumentation--Questions and answers on the Electron Microscope--Questions and Answers on X-ray Diffraction, Diffractometry and Spectrography: Free Chart: X-ray Spectrography Chart showing characteristic X-ray lines which identify elements from atomic #11 (sodium) to atomic #98 (Californium). Free: 30 minute movies available to high school teachers for science classes. The Ultimate Structure, shows principles, operation and application of X-ray diffraction, diffractometry and spectrometry (for analysis of atomic structure and elements). Terra Incognita, shows principles, operation and application of Electron Microscope (for physical structure analysis).

The Philosophical Society of Washington, Lawson McKenzie, Corresponding Secretary, Code 103-Office of Naval Research, Washington 25, D.C. Consulting service, as available, will be furnished free. The Society is affiliated with the American Institute of Physics but is devoted to Natural History. Expert advice is thus available in many areas.

Pitman-Moore Co., P.O. Box 1656, Indianapolis 6, Indiana.: Free: Reprint: entitled, "Tissue Culture One Key to Medical Progress."

Pittsburgh Plate Glass Co., 632 Duquesne Way, Pittsburgh 22, Pa.: Free Booklets for teachers only: The Romance of Glass--50,000 Years of Protection and Decoration, a History of Paint and Color.

Podiatry Society of the State of New York, 353 W. 57th St., New York 19, N.Y.: Free to Science Clubs: Booklets, Foot Care in New York State--Foot Care--Diabetes--Children's Feet--Middle-aged Feet.

The Porter Chemical Co., Pennsylvania and Prospect Ave., Hagerstown, Md.: Free Booklets: The Wonders of Science, lists details of the $1,000 College Scholarship Contest. Explains how to join Chemcraft Science Club and receive membership certificates and handbook. Your World of Science, useful laboratory information and charts. Describes the Atom, explains how chemists measure. Discusses metric units of weight and volume. Illustrates operation of microscope. Numerous home experiments and safety rules for home laboratory. Also gives information on $1,000 Scholarship Contest.

The Prospectors Shop, SCA, 201 W. San Francisco St., Santa Fe, N.M.: Free: Bulletin #26 listing mineral specimens and ore samples for advanced collectors and students, gems and gem materials, equipment, etc.

Public Affairs Committee, Inc., 22 E. 38th St., New York 16, N.Y.: Free:

List of Public Affairs Pamphlets (single copies at 25¢ each) gives dozens of titles such as: Disabled--Mental Health--Science vs. Chiropractic--New Medicines for the Mind--Alcoholism--TB--How to Live with Heart Trouble--Good News About Diabetes--Medical Research May Save Your Life:--Cigarettes-Lung Cancer?--Psychologists in Action--Your Family's Health--Good News for Stroke Victims--Effects of Radiation and Fallout--Allergy--A Story of Millions--Water Fluoridation: Facts not Myths--Your Community's Mental Health--Your Operation--W.H.O, Its Global Battle Against Diseases.

Radio Corporation of America, Educational Services, Camden 2, N.J.: Free Bulletin: How a Phonograph Record is Made. Booklet: How to Understand High Fidelity, 25¢.

Radio Corporation of America, RCA Electron Tube Div., Harrison, N.J.: RC-18 Receiving Tube Manual, 75¢--Tube Picture Book, 25¢--IT-4 Transmitting Tube Manual, $1.00--SCA-109A Book of Transistors and Semiconductor Diodes, 25¢.

Railway Express Agency, Inc., Public Relations Division, 219 E. 42nd St., New York 17, N.Y.: Free Booklets: The Air Express Story--Expressing America.

Rand McNally and Company, P.O. Box 7600, Chicago 80, Ill.: Large wall Map of the Moon, based on Photographs taken by the Lick Observatory at University of California, Berkeley. Side panels provide blow-up photographs from Mount Wilson, and Palomar observatories, of some of the major features of the moon. Map of the planets on the reverse side of the map, shows size and distance relationships, information and diagrams of diameters, eclipses, tides, seasons, the earth and its atmosphere, and Halley's Comet. Map also contains full-color drawings of the Jupiter and Vanguard rockets and the first American Satellite. Price, $1.00.

Ray-O-Vac Company, Department SCA, 212 E. Washington Ave., Madison 10, Wis.: Free: Portable Power, 16-page booklet describing the history, development use, basic construction and operation of the dry cell battery. Illustrated and written for easy understanding at practically any grade level. Free: Photoflash Systems, 15-page illustrated folder provides a "primer" on the three basic systems of photoflash photography--conventional battery, "B-C" battery-capacitor and electronic. Tells what each system is, how it works, what type of batteries are used and the advantages anddisadvantages. Written clearly and concisely.

Rhode Island Medical Society, 106 Francis St., Providence 3, R.I.: Library: Open to the public for reference. The staff will help students to find data for research papers and science projects in the field of medicine.

Rohm and Haas Co., Washington Square, Philadelphia 5, Pennsylvania: Free literature on the fabrication of Plexiglas.

The A. I. Root Co., Medina, Ohio: Free Booklets and Pamphlets: The Story of Pollination, Why bees are indispensable in Orchards--The City of Bees. Books: Starting Right with Bees, 95¢--500 Answers to Bee Questions, 95¢.

Harry Ross, Scientific and Laboratory Apparatus, 61 Reade St., New York 7, N.Y.: Booklets and Information Sheets: Simple Microscopical Techniques, Booklet, 30¢--Glass Lens Magnifiers, 2 pp., 10¢--Mineralogy Handbook Booklet, 25¢--Soil Testing Manual, Hydrion, 25¢--Tricks with Alnico Magnets, 1 p., 10¢--Become a Weather Prophlet, 10¢--Black Light, Directions and Instructions for Fluorescence, 1 p., 10¢--Polarized Light, theory tests for and with chemical slides, 10¢--How to Adjust Field Glassess-10¢--Instructions for the Use of Test Gratings, 10¢--Making your Own Galilens Telescope, 10¢--Telescope Finder, 10¢--Herschel Prism Wedge and Safety Sun Filter, 10¢.

Rothacker, Inc., 729 Seventh Ave., New York 19, N.Y.: Free list of selected Educational Motion Pictures on scientific subjects for loan. Films are free of charge including transportation costs.

Row, Peterson and Co., Evanston, Ill.: Free Folder: The Basic Science Educational Series lists all books in this series for grades 1-9. Each title in series, 48¢ for Elementary and Intermediate; 52¢ for junior high school titles. Total of 83 books.

St. Louis Medical Society, 3839 Lindell Blvd., St. Louis 8, Mo.: Free: A simple four-page leaflet which records the observations of physicians, research scientists, medical school instructors and students who entered biological scientific exhibits in the St. Louis Science Fair. The Society presents "How to do it" session for prospective entries and records the information in this pamphlet. Single copies free; 5¢ each in quantities.

Salada-Shirrif-Horsey, Inc., Dept., SCA, Stuart and Berkeley Sts., Boston 16, Mass.: Free Booklet: Tea-A Gift for a Queen. Restricted distribution: New England, N.Y., N.J., Del., Mid, D.C., Pa., Ohio, Mich., Ind., Ill., W. Va., Va., Fla.

Gordon S. Salisbury and Robert H. Sheridan, P.O. Box 943, Riverside, Calif.: Catalog of Free Teaching Aids: A book of over 150 pages which lists over 5,000 free teaching aids which are available to educators and club sponsors. Includes informative booklets, charts, maps, pictures and posters, covering all fields of science, geography, history, mathematics, shop courses, vocational guidance, Etc., $1.50, postpaid.

School Products Co., 330 E. 23rd St., New York 10, N.Y.: A History of Weights and Measures, W-7, how we got the weights and measures we use today; how the makeshift devices used at first became standardized--50¢. How Man Learned to Fly, A-9, how man has conquered the air. It begins with man's earliest attempts to fly and continues to the modern (pre-jet) military planes and the helicopter. It describes experiments which middle grade youngsters can perform to understand aeronautics--60¢.

Schroder and Termanvne, Inc., 1711 Delmar Blvd., St. Louis 3, Mo.: Free Leaflet: The Story of Sponges and the Story of Chamois.

Science Associates, Box 216A, 194 Nassau St., Princeton, N.J.: Free: Folder illustrating and describing weather instruments, both amateur and Weather Bureau types.

Science Service, 1719 N St., N.W., Washington 6, D.C.: See listing on Science Service Aids for Science Clubs on back pages of this book.

Scientific Apparatus Makers Association, Director of Public Information, 20 N. Wacker Drive, Chicago 6, Ill.: Free: Such pamphlets as A Guide to Evaluating Your Science Facilities--Selected Bibliography on Science Education and Careers--How to Help Your Town's Editor--Industry Stimulates Interest in Science--I am the Science Teacher--Guidance and the Scientific Manpower Shortage--The SAMA Motion Picture Film Director.

Scientific Manpower, 1507 M St., N.W., Washington 5, D.C.: Teachers may make inquiries.

O. M. Scott and Sons, Marysville, Ohio: Free: Lawn Care Magazine, timely reports from Scotts Research, published 5 times each year.

Sealtest Consumer Service, 260 Madison Ave., New York 16, N.Y.: Free posters: The Basic Seven and other posters. Free Leaflets: Kitchen Measures--Some Goods Go Together. Manual: Handbook of Dairy Products--Milk. (free to teachers only).

W. A. Sheaffer Pen Co., SCA Dept., 311 Ave., H, Fort Madison, Iowa: Free Reprints: Chemistry of Ink Stain Removal from Fabrics—Spectrophotometry for Chemists Prussian Blue Writing Inks--Experiments with Writing Inks--Writing Inks--Testing Writing Inks--Ball Point Pens and Inks—Behavior of the Ball Point Pens and Inks. Free Leaflet: Case of the Disappearing Spot, directions for the removal of various inks from fabrics, floors, skin.

Shellac Information Bureau, 51 Pine St., New York 5, N.Y.: Free: Single copies of booklets and literature--Shellac, How to Use It--Shellac Works Better--Good to Look At, But Tough as They Come, How to Give a Rich, Satiny Finish to Your Unpainted Furniture with Shellac.

Shell Oil Co., Pub. Rel. Dept., 50 W. 50th St., New York 20, N.Y.: Free Booklets: The Story of Petroleum--Let's Collect Sea Shells. Free Motion Picture Catalog of 15 mm, sound films of all aspects of petroleum. Some are in color.

Shenandoah Natural History Assn., Shenandoah National Park, Luray, Va.: 101 Wildflowers of Shenandoah National Park by Grant and Wenenah Sharpe. Price $1.00 plus 10¢ postage. The Mammals of Shenandoah National Park by Richard H. Manville. Price 50¢ plus 10¢ postage.

Shipley's Mineral House, Gem Village 13, Bayfield, Colo.: Free: Mineral Specimen list, gives names of typical mineral specimens and price. Specimens are priced low, to encourage the story of minerals and crystals. Free; Listing of books devoted to the study of minerals, crystals, fossils, dinosaurs and how to cut and polish semi-precious gem stones. These books range from children's class to advanced adult education, also books and maps on mineral locations. Please send 4¢ stamp for mailing.

Single Crystal Corp. of America, Saxonburg Blvd., Saxonburg, Pa.: Free:

Single crystals of various elements in organic and inorganic single crystals used in the Nuclear field, Optical field, Semi-conductor field, and thermo-electric field and others. Provisions are that reports of studies made on these crystals can be furnished.

Society for French American Cultural Services and Educational Aid, 972 Fifth Ave., New York 21, N.Y.: Free: Catalog of Lending Collection. Lists audio-visual material prepared in cooperation with American teachers. SCA sponsors will find useful material on crafts, geography, science of France.

Society for Pennsylvania Archaeology, Pa. State Museum, Harrisburg, Pa.: Pamphlets: J. Witthoft--A Brief History of the Indian Hunter, 25¢. The Indian Hunter, 25¢ postage paid. Magazine, Pennsylvania Archaeologist, quarterly, $3.00 annum membership. Jr. membership is $1.00 per year.

Society for Visual Education, Inc., Dept., SCA, 1345 W. Diversey Parkway, Chicago 14, Ill.: Free: Complete Educational catalog of filmstrips, 2" x 2" slides and slidesets containing one complete section devoted to science.

Society of Actuaries, 208 S. LaSalle St., Chicago 4, Ill.: Free: Pamphlets describing the profession of Actuary andthe examinations for qualifications.

Society of American Foresters, Mills Bldg., Washington 6, D.C.: Booklet: Forestry as a Profession, 25¢. Free: List of Accredited Schools of Forestry.

Society of Economic Paleontologists and Mineralogists, Box 979, Tulsa 1, Okla.: Free: Price list of back issues of the Journal of Paleontology and the Journal of Sedimentary Petrology--also includes prices of special publications such as Finding Ancient Shorelines--Recent Marine Sediments--Regional Aspects of Carbonate Deposition--Index to Journal of Sedimentary Petrology.

The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N.Y.: Free: Motion Picture Film Catalog of the Plastics Industry. Free Booklet: Plastics, The Story of an Industry, 40 pages, covering briefly all branches of the Plastics Industry.

The Soil Conservation Society of America, 838 Fifth Ave., Dept. S. Des Moines, 14, Iowa: The Wonder of Water, 16-page, four-color, cartoon-style booklet about water and its control. 20¢ single copies--The Story of Land, 16-page pictorial book about soil conservation, single copies 10¢. Glossary of Soil and Water Conservation, 50¢ a copy--Land Utilization in the United States, technical information on land utilization problems, 50¢ a copy. Our Watershed Resource, a semi-technical publication on upstream flood control and watershed development, 50¢ a copy--Journal of Soil and Water Conservation, official publication of Soil Conservation Society of America, bi-monthly, $5.00 a year.

Solar Aircraft Company, 220 Pacific Highway, San Diego 12, Calif.: Attn: Public Relations Division. Free: 4-page brochure, Engineered for Power, a review of modern aircraft power systems.

Sonotone Corp., Elmsford, N.Y.: Free: Description of a film strip with sound, Our Wonderful Ears: can be borrowed at no cost.

Sperry Gyroscope Co., Div. of the Sperry Corp., Marcus Ave., and Lakeville Road, Great Neck, L.I., New York: Free Booklet: The Gyroscope through the Ages.

Stanley Tools, New Britain, Conn.: Free Booklet: The Joy of Accomplishment. Free Bulletin: Stanley News and Order Forms. Lists tools, booklets, film strips, etc., available. Stanley Plans, sets Nos. 1 to 19 (each set contains designs and specifications for 5 projects easy to build), 10¢ each. Stanley Tool Guide (gives directions for using all tools), 24¢. Stanley Plans of Early American Designs: Packets A, B, C and D; 15 plans in each: 25¢. Toy Patterns, P1 and P2, 6 plans in each; 25¢ each. Six Workshop Patterns, P3, 6 plans for 25¢. Stanley Plans of Conservative Modern Furniture Projects, CM1, CM2, CM3, 5 plans in each, 25¢ each. Book: How to Work with Tools and Wood, $2.00. Paper covered, 25¢ each.

Sterling Movies U.S.A., Inc., 6 E. 39th St., New York 16, N.Y.: For the American Association of Colleges of Pharmacy: Films: Design for Life. A boy's choice of Pharmacy as a career. 16mm color, sound. Free except return postage. Time for Tomorrow, the educational program in Pharmacy. Free except return postage.

Strathmore Paper Co., West Springfield, Mass.: Free Booklet for teachers only: Quality Papermaking, the Strathmore Way (as long as supply lasts).

Swift and Company, Public Relations Dept., SCA, Union Stockyards, Chicago 9, Ill.: Free Pamphlets: March to Market (comic book style) describes services of the meat packing industry in providing food for the nation. Eat Right to Win (comic book style) is a story of nutrition. Films to Loan: Red Wagon--Nation's Meat--Big Idea--Food for Life.

Teaching Film Custodians, Inc., 25 West 43rd St., New York 36, N.Y.: Low Cost Rental Films to Schools and Colleges only. Write to your nearest city, country, state university or college for science films made available for the motion picture industry through Teaching Film Custodians. Films have been selected for use in the following subject matter areas: Arithmetic, General Science, Science Biography, Biology, Geology, and Physical Geography, Meteorology, Home Economics, Psychology.

Texas Gulf Sulphur Company, Room 1701, 811 Rusk Ave., Houston 2, Texas: Free Chart: Products in Manufacture in Which Sulphur is Required--Free Booklets: Sulphur Mining--Rose Disease--The Culture of Camellias and Azaleas--Sulphur, Its Occurence and Uses--Sulphur and Soils.

Boyce Thompson Institute for Plant Research, Inc., Yonkers 3, N.Y.: Sponsors and club members interested in projects involving research with plants can request a list of titles of reprints on work done there. The Institute has no courses to offer.

Thorne Films, Inc., 1707 Hillside Road, Boulder, Colo.: Free: Catalog of films available for rental or purchase, including: Orders of Insects--30 min.--Sound--Color-15mm. High School level (advanced). On the nine most common orders of insects, showing characteristics and habitats. Sunken Forest 10 min--Sound--Color--16mm. High school level. On the unusual Holly forest, located at Fire Island Beach, N.Y., which was saved from man--destruction by conservation minded people of the area.

Ultra-Violet Products, Inc., Dept. SCA, San Gabriel, Calif.: Bulletins 5¢ each: Fluorochemistry in Petroleum Science--The Ultraviolet Light in Criminology--The Ultraviolet Lamp in Scientific Research--Ultraviolet Light as an Aid to Education--Fluorobiology--Fluorochemistry in Food Science--Ultraviolet Light in Mercury Prospecting--Ultraviolet Light in Uranium Prospecting--Luminescence in Gem Science--Fluorescence for the Hobbyist--Ultraviolet Light in Sheelite (tungesten) Prospecting.

Underwood Corp., One Park Ave., New York 16, N.Y.: Free Booklet: The History of the Typewriter.

Underwriters' Laboratories, Inc., 207 E. Ohio St., Chicago 11, Ill.: 161 Sixth Ave., New York 13, N.Y.--1655 Scott Lane, Santa Clara, Calif.: Free Reprints: You are Safer Than You Know--The Label that Saves Lives--The Arsonists of E. Ohio St.,--Testing for Safety from Fire, Casualty and Burglar Hazards. Free Pamphlets: Safety for You--Electrical Appliance and Utilization Equipment List--Electrical Construction Material List--Hazardous Location Equipment List--Fire Protection Equipment List--Gas and Oil Equipment List--Accident, Automotive and Burglary Protection Equipment List. Leaflet on Motion Pictures: Album of Public Safety--Danger Sleuths, stories of protection of life and property from fire accident, crime.

Union Carbide Corporation, 30 E. 42nd St., New York 17, N.Y.: Free Booklet: The Petrified River, the Story of Uranium. Film: The Petrified River.

Union Pacific Railroad Co., Pub. Rel., 1416 Dodge St., Omaha 2, Nebr.: Free booklets: Along the Union Pacific Railroad--Brief History of the Union Pacific. Free: Map of the United States.

United Air Lines, Inc., School and College Service, 5959 S. Cicero Ave., Chicago 38, Ill.: Free: list of Free Aviation Education Materials and Services.

United Fresh Fruit and Vegetable Assn., 777 14th St., N.W., Washington 5, D.C.: Free: list of publications and materials. Free: Nutrition Notes series--These are brief notes in non-technical terms on a wide variety of nutrition topics. The information is from standard medical and scientific publications. Reference to source of each note is given. Issued from time to time at no fixed dates. Copies of current and back issued free on request to those who have need for such information, including those studying nutrition science. A statement should be made by the applicant of what special interest he has in this subject. Broadcast or general distribution is not sought.

U.S. Industrial Chemicals Co., Div. National Distillers and Chemical Corp., 99 Park Avenue, New York 16, N.Y.: Free Booklets: Products of USI—Story of Industrial Alcohol (contains chart of uses of industrial alcohol.)

United States Steel Corp., Public Relations Dept., 71 Broadway, N.Y. 6, N.Y. Free to teachers: Teaching aids and educational materials, including visual aids. Reading List of Publications and Catalog of Visual Aids, both for elementary and secondary schools--Reading List of Publications for Colleges and Universities. An Annual Digest of Technical Papers gives summaries of scientific and technical studies made by the Corporation's personnel in: engineering sciences, business administration and economics, and mining and geology. Booklets: leaflets and brochures especially prepared with the assistance of educators and classroom tested are available. In addition, there are kits, including one with a colored film strip showing how steel is made, containing samples of raw materials, pig iron and steel. Most of the materials may be used in general science, chemistry, shop and social studies classes in academic and vocational high schools. Some are helpful from the fifth to seventh grades. Certain of the materials are available in classroom quantities if requested by the teacher. Motion pictures are loaned free of charge. Selections may be made from a catalog of all U.S. Steel films available through the U. S. Steel Film Distribution Centers.

United World Films, Inc., SCA, 1445 Park Ave., New York 29, N.Y.: Free: Catalogs describing U. S. Government motion pictures and film strips for sale at reasonable cost. Catalogs available on films in the following categories: Physical Geography--Mathematics--Astronomy--Biology--Botany--General Science--Meteorology--Gyroscopes--Atomic Physics--Electricity--Optics--Physics. Filmstrip: Introduction to Numbers, 32 frames, $1.00.

Unitron Instrument Division of United Scientific Company, Dept. SCA, 204-206 Milk St., Boston 9, Mass: Free: unitron Astronomical Telescope Catalog which includes the Observers' Guide. A 50-page booklet containing full-page illustrated articles on astronomy, observing, helpful hints for the amateur astronomer; also a glossary of astronomical terms. Seventeen different refractors and one, especially designed for satellite watching, are fully described together with many useful telescope accessories. Available free to Science Teachers, Science Club Members and in limited quantities for classroom use.

Universal Scientific Co., Inc., Box 336U, Vincennes, Ind.: Free Leaflets: Describing experimental equipment for use by beginners in electricity and electronics.

University of Illinois, Small Homes Council, Mumford House, Urbana, Ill.: Series of bulletins on home planning, construction and maintenance, available for 15¢ per bulletin. Send for free list of publications from 15¢ to $2.50.

D. Van Nostrand Company, Inc., 120 Alexander St., Princeton, New Jersey: Free: Information and prices on such books as--Introducing Seashells, 70 pp., ill.--Science Experiences with Home Equipment, 224 pp. ill.--Science Experiences with Inexpensive Equipment, 280 pp., ill.--Science Experiences with Ten-Cent Store equipment, 276 pp., ill.

Venus Pen and Pencil Corp., Adv. Dept., SCA, Hoboken, New Jersey: Booklets: (D) Sketching with Venus Pencils, 28 pp., ill.,--25¢--(C) Venus Drawing Prize Winners, 10¢. Free Booklets: Story of the Lead Pencil--Painting with Venus Coloring Pencils. Free: Venus coloring pencil sampler--Venus Drawing Brochures on Jet Propulsion--Atomic Energy.

Victor Chemical Works, 155 N. Wacker Drive, Chicago 6, Ill.: Free Folders: Series of folders showing applications of Victor phosphates, formates and oxalates.

Ward's Natural Science Establishment, Inc., P.O. Box 1712, Rochester 3, N.Y.: Free: Nature Guide Catalog: lists materials for mineral and fossil collectors, insect collectors, plastic embedding, and many other natural science hobbies.

Washington State Apple Commission, P.O. Box 18, Wenatchee, Wash.: Free Booklets: The Story of Washington Apples. Free Film: Appleland. Free Chart of apple growing areas of Washington.

West Coast Lumberman's Association, 1410 S. W. Morrison St., Portland 5, Oregon: Free Booklets: The Story of West Coast Lumber--A Million Homes a Year. Free Chart: The Lumber Contents of a Douglas Fir Log. Free: Filmstrip, 66-frame black and white, entitled The Story of West Coast Lumber.

Western Pine Assn., 510 Yeon Building, Dept. 5, Portland 4, Oregon: Free: Leaflet: Price List of Plans. Lists free handicraft project plans. Small charge for quantities. Free Booklets: Plan Book for the Boy Builder--Wood Carving for Pleasure--Wood Turning in the House Workshop--Forest Crops Are Growing--Free Farms of the Western Pine Region. Free Folders: Facts about: Ponderosa Pine, Sugar Pine, Idaho White Pine, Lodgepole Pile, White Fir, Engelmann Spruce, Incense Cedar, Western Red Cedar, Larch, Douglas Fir. Also Western Pine Region Timber, folder illustrated with pictures of trees, bark, needles and cones. Facts andfigures about Western Pine Region's timber supply. Unfolds to a simplified tree guide chart. Information on sound motion picture film, The Bounty of the Forest.

Wheat Flour Institute, 309 W. Jackson Blvd., Chicago 6, Ill.: Free Booklet: From Wheat to Flour. Filmstrip: Judy's Family Food Notebook (for elementary students) for sale $2.00 with narration guides.

The Wilderness Society, 2144 P St., N. W., Washington 7, D.C.: Free information will be furnished on wilderness preservation. Magazine: The Living Wilderness, $2.00 per year. (quarterly).

The Wild Flower Preservation Society, Inc., 3740 Oliver St., N. W., Washington 15, D.C.: Free: List of bulletins, circulars color plates, outline drawings, posters, visual aids, books, color slides and lectures. Wild Flower Slide Films 26-35mm, single frames, uncolored, $2.00. Four Films: Early Spring Flowers--Late Spring Flowers--Early Summer Flowers--Late Summer Flowers. Books for Mounting Plants, 20 pages bound, 75¢.

Wildlife Management Institute, 709 Wire Bldg., Washington 5, D.C.: Free booklets (in single copies): Federal Aid in Wildlife Restoration--Upland Game Management--Quail and Pheasant Propagation--Waterfowl Management on Small Areas--The Farmer and Wildlife.

Wine Institute, 717 Market St., San Francisco 3, Calif.: Free: Reprints on the Wine Industry.

The Wisconsin Archaeological Society, Milwaukee Public Museum, Wis.: Magazine: The Wisconsin Archeologist, $2.00 per year (quarterly).

The Wool Bureau, Inc., 16 W. 46th St., New York 36, N.Y.: Free Leaflets: Knowing your Wool Facts, a guide to teaching aids, lists such items as: Wool--The Structure of the Wool Fiber--Wool as an Apparel Fiber--Theses and Dissertations on Woold Accepted by Principal American Universities--Carbonizing Wool Stock, an improved sulphuric acid method.

Wright-Patterson Air Force Base, Ohio: Director of Advertising and Publicity, 3500th United States Air Force Recruiting Wing. Free Leaflets: Explore the Future--Opportunities for You in the New Age of Space--U. S. Air Force Guided Missile Systems--The Air Force Nurse--Women in the Air Force. For loan to organized groups: Films on a large number of scientific subjects.

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